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EARLY DAYS OF THE WESTERN SURGICAL ASSOCIATION

Presidential Address

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TOPEKA, KAN.

IT IS an honor to serve as president of the Western Surgical Association, a major national surgical organization which has contributed much to the development of surgery in the United States. While our members come from widely separated localities, all feel a common pride and bond in what the word "Western' 'in our name implies. All the country north of the Ohio, all the Missouri Valley, a large part of the Mississippi basin and the whole Pacific coast contribute to our membership.

As president, I am expected at this meeting to present a paper, by courtesy called an address, on a subject of my choosing. In recent years scientific papers have been the rule, although the presidential addresses of Dr. Fred Bailey, Dr. Vernon David and Dr. Alfred Brown were notable exceptions to this custom. In a program of this size and caliber, the absence of one surgical paper will not be noticed: therefore, I am going to revert to the early days of the Western Surgical Association.

My interest in this subject was aroused at the time of our fiftieth anniversary in 1940. The anniversary meeting was held in Topeka, my home city and the city where our organization was founded. Dr. Brown, in his address that year, noted the fact that, although we had complete records in our transactions beginning with the meeting of 1897, we had no records for the years 1891 through 1896, although medical journals of that early period carried the meeting programs. In addition, an "index," in tabular form, of the activities of our members for the years 1891 to 1927 had been published by Dr. Carl Black; but, with these two exceptions, the history of our first six years is sadly lacking, due to the loss of our original records.

With the cooperation of librarians in the Middle West and the Army Medical Library, some material has been secured from which the time and programs have been reconstructed. Complete published transactions for the year 1893 were found in the library of the College

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of Medicine, Universiy of Nebraska, and similar records for 1896 were located in the Army Medical Library in Washington, D. C. As these copies are apparently the only ones in existence, photostats have been made for the records of our society.

In the early nineties there was great interest in both surgery and gynecology. Both fields were steadily becoming safer and, therefore, attracting more men, in spite of the dearth of any graduate training in surgical specialties. The total amount of abdominal operations performed was pitifully small, as witness the work of Dr. Summers, professor of surgery at the Omaha Medical College. In his paper on Trendelenburg's position in pelvic surgery, Dr. Summers stated that in the six months from July 1 to Dec. 28, 1892, he had performed a total of ten abdominal operations. He also noted that his iron frame could be fastened to any kitchen table, securing good position of the patient.

A month later the *Kansas City Medical Index* carried the following advertisement: "There are two vacant professorships to be filled in a prominent Chicago medical college. Parties desiring to apply please address Professor C., 813 West Harrison St., Chicago, Illinois." Faculty positions were apparently filled neither by promotion nor by invitation.

THE ASSOCIATION IS BORN

To go back to 1891, we find that one personality was preeminent in the formation of the Western Association of Obstetricians and Gynecologists—our original title. That person was Milo B. Ward of Topeka, a gynecologist. Ward had run away from home at the age of 15 to enlist in the Union Army in the Civil War. Later, he studied telegraphy, then had a preceptorship and finally was graduated from the College of Physicians and Surgeons in Keokuk, Iowa, in 1871. He served for a few years as chief surgeon for the Mexican Central Railway at Chihuahua, Mexico, where he built a company hospital.

Dr. Ward came to Topeka in 1885 and practiced there until 1897. I, a small boy at the time, remember when the good physician was called in consultation at the last illnes of my grandmother. The disease was correctly diagnosed as peritonitis secondary to gallstones, which was later proved by postmortem examination, but operation was not recommended.

Dr. Ward was a fine commanding figure and a man of pronounced literary tastes. In Topeka, he at first had a private hospital and later was a principal in the founding of Stormont Hospital. Having prepared himself for his specialty by work with Dr. Joseph Price, of Philadelphia, and by frequent attendance at national and interna-

tional societies, he held the chair of professor of gynecology at different times in two medical schools.

It was at this stage of his career that Dr. Ward conceived the idea of forming an association for surgeons of the West— an association for the exchange of ideas and discussion of questions of interest common to all the members. In October 1891, Dr. Ward sent out the call for a meeting to be held in December at the Copeland Hotel in Topeka for the purpose of organizing the Western Association of Obstetricians and Gynecologists. The membership was to be limited to specialists residing in the following states and territories: "the Missouri River cities of Iowa and Missouri, the states of Kansas, Nebraska, and Colorado, New Mexico, and Indian Territory and Oklahoma."

MEETING OF 1891

At the appointed date in December, the organization was formed with forty-two charter members, one of them a woman, Dr. Ida Barnes. Each of the physicians present made one or more "addresses" on the project, all of them apparently favorable. A constitution and by-laws were adopted, with the name given in the heading. The "object," as expressed in article 11 of the constitution, "shall be the promotion and diffusion of knowledge in whatever pertains to abdominal and pelvic surgery—obstetrics and gynecology."

MEETING OF 1892

Dr. Ward was elected first president of the infant organization, serving for two years, and at the next meeting, in Kansas City, Kan., on Dec. 27, 1892, he said prophetically, "Let us not despise the day of small things, although we are few in number and as yet unrecognized by the medical and surgical world." At this same meeting, Joseph Price of Philadelphia presented a paper on tubal pregnancy and performed a laparotomy at the Scarrit Hospital. (An item in the *Kansas City Times,* Dec. 28, read: "This afternoon Dr. Joseph Price of Philadelphia, ranked as one of the most eminent surgeons in the United States, will perform a difficult operation before the members of the association at the Scarritt Hospital.") This was the first clinical session of the association.

MEETING OF 1893

We now have for study the full transactions of the next annual meeting, which was held in Des Moines, Iowa, in 1893. Dr. Joseph Eastman of Indianapolis was there, with a paper on vaginal hysterectomy; he became a member of the association. This meeting is notable for the presence on the program of the first purely surgical

subject, recurring appendicitis, with a report of a case, by Dr. Joseph W. Young. In the discussion following Dr. Young's paper, Dr. Jonas of Omaha said that he had drained an abscess of the appendix in 1878, but did not know what it was. He also relates, "Later, following Lawson Tait, I began to use salines with these cases of appendicitis with the most gratifying results and I yet have to meet with the first case in which I have occasion to regret having applied them. I use salines not only for the purpose of acting as a curative agent but as an indication that it is time for an operation. I give salts or seltzer aperient a teaspoonful every hour until watery evacuations occur, usually in six hours." If the saline laxative was ineffective, he operated.

Dr. Franklin Martin of Chicago was not present to read his paper, but, after some debate, the secretary was instructed to read it. "Report of Results in My New Operation of Vaginal Ligation of the Broad Ligaments for Uterine Fibroids" was the title. The audience would have felt his appearance a treat, since his statistics at that time of 16.66 per cent mortality in 66 cases in which hysterectomy for cancer of the uterus was performed were the best reported. Too, the removal of the whole uterus instead of just the cervix was regarded as a real innovation.

Another famous man, Dr. E. E. Montgomery, of Jefferson Medical College, failed to appear on the program, and his paper was read by title. Dr. Lewis Schooler of Des Moines, Professor of Surgery at Drake University, was elected president; and Omaha was chosen for the meeting of December 1894.

MEETING OF 1894

The Omaha meeting has left only a small imprint on medical annals, as only the program and a few of the papers have been preserved. However, we know that three general surgical papers were presented, including the first one on experimental work, entitled, "Some Recent Experiments in Ureteral Surgery," by Byron B. Davis of Omaha, father of one of our officers. Four authors scheduled to present papers were absent. The attendance was small; less than twenty out of a limited membership of one hundred were present, and these came largely from a radius of 100 miles. Arthur L. Wright was elected a member, and he has left a vivid account of a controversy which arose.

Because there was so little surgical treatment in those days, only a few of the physicians present confined their work to operation. An effort was therefore made to change the character of the association

by increasing membership and by dropping any requirements of specialization, thereby opening membership to all physicians. Dr. Wright said:

> I distinctly remember the feeling and deep emotion with which Dr. Ward spoke on this point and on the importance of surgeons in this Western Country uniting for the sole purpose of discussing questions and methods of interest to them only. He maintained that to accomplish the purpose of its creation it was necessary that membership should be limited; that it should be representative in character and though its conditions of membership were exacting it should not be used for selfish motives. The intention was not to exclude meritorious candidates but to prove their qualifications. He insisted that though the membership was small it would soon include the leading men of the West and that the influence of our organization would be widespread.

This was a crisis, representing the lowest point in morale and the actual turning point to a brighter future. The arguments and predictions seem truly prophetic when viewed in retrospect.

John E. Summers Jr., of Omaha, was elected president. He was probably the best trained of the early leaders. The son of an army surgeon, a graduate of the College of Physicians and Surgeons in New York, he had spent two years in study in Europe. He was a frequent and valuable contributor to our meetings and to many journals. One thing that he said of others applied especially well to himself:

> I believe that the spirit of this part of the country develops the unusually good self reliant, all around man, hence the progressive physician and the specialist with a good foundation.

Many years later, in 1932, William J. Mayo said:

> When one attempts to estimate the progress of medicine in the Missouri Valley in the last forty years, one realizes that the leadership which has given character to the splendid professional advance has come through a relatively small number of men. One of these great leaders of the generation just passing is John E. Summers.

MEETING OF 1895

At the meeting of 1895 in Kansas City, the program was shorter, but all the essayists were there. The most important business transacted changed our name to the Western Surgical and Gynecological Association, which change forced the obstetricians to "walk the plank." (A few years later, in 1909, the gynecologists were victims of a purge, when our present name was adopted, and we became the Western Surgical Association.)

MEETING OF 1896

However, let us go back to the earlier change. Limitation of membership to surgeons and gynecologists was doubtless necessitated by the growing importance of general surgery. This is shown by the newly found transactions of the meeting of 1896, held at Topeka in the senate chamber of the capitol, under the guidance of the president, Thomas J. Beattie, of Kansas City, Mo. Surgical clinics were held in

three hospitals. General surgery had its fair share of the program, which included papers on these subjects: "Amputations," "Etiology of Malignant Disease," "Gastrorrhaphy," "Imperfections in Abdominal Diagnosis," "Remote Effects of Bone Disease" and "Surgical Iodoformism." It is interesting to note the intense interest and general participation in the discussion of those papers; indeed, the recorded discussion frequently exceeds the length of the paper discussed.

They were hardy souls in those days. After a day's meeting and an evening session of papers, a banquet was served at 11 p.m. at the Copeland Hotel. Following the banquet, toasts were proposed, seven in number, on the following subjects: (1) the future of the Western Surgical and Gynecological Association, (2) the medical profession of the West, (3) a silver thread among the gold, (4) the clergy's opinion of the profession, (5) the city health regulations and (6) specialization in medicine.

The seventh toast probably received the greatest applause. It was entitled "Goodnight."

THE ASSOCIATION COMES OF AGE

By this time the "Western" was definitely past its sometimes turbulent infancy and recognized as an important sectional surgical society, limited in number of members, attracting the leaders in surgical practice and education and giving annual programs worthy of recording in the transactions. The next decade saw the society reach the position it has since maintained, with a membership truly representative of the best surgical talent in an area which had enlarged to the present dimensions.

It is interesting to survey the facilities availabe for training in surgery during the period under discussion. In general, the training of our early members began with a preceptorship under a general practitioner. This was followed by a rather elastic period, commonly three "years," of twenty-six weeks each, in a medical school which conferred a degree of Doctor of Medicine. From this point, there was no beaten path to follow in becoming a surgeon, since the hospitals were too few in number to train the many physicians graduating from proprietary medical schools as well as medical schools with university supervision. Internships of a rotating type—usually of only one year's duration—were available for only a small fraction of the graduates. A few secured training as assistants to established surgeons, but the usual thing was to visit operative "clinics" in this country or in Europe when seeking postgraduate training.

Dr. Samuel C. Harvey has said, "These experiences were in some instances of great value, but frequently only casual and served as generally informative rather than as a specific training."

We have the greatest respect for the early day surgeon, for his courage and candor, but we know that the young surgeon today has a vastly superior training. The Western Surgical Association has played an important role in encouraging specialization, in providing from the start education of its members through programs and clinics and in developing graduate surgical training. Many of our members have been active in fostering the resident house staff system, which has been a great contribution to the graduate training of surgeons. Beginning with our last session, papers presented at our meetings are published in the ARCHIVES OF SURGERY as well as in our transactions.

In addition, our organization, not only through individual members, but officially, is a part of the American College of Surgeons and the American Board of Surgery, respectively. While we antedate by many years both of these organizations and support them both, we should not become a static society intrusting to others the entire task of providing and certifying honorable, intelligent and skilful surgeons. We must remain a dynamic organization, with membership in the Western Surgical Association the most coveted goal of the many splendidly trained certificated young surgeons of today. Our future will be determined by you younger members, and it will be limited only by the thought and effort you devote to our problems.

TUMORS OF THE STERNUM

Report of a Case with Special Operative Technic

J. DEWEY BISGARD, M.D.

AND

SAMUEL A. SWENSON JR., M.D.

OMAHA

THE PRINCIPAL indication for resection of the sternum and adjoining costal cartilages, either totally or in part, is neoplastic disease. There are a few instances of resections for tuberculosis, osteomyelitis and traumatic lesions, and on occasion a part of the sternum has been removed to gain access to retrosternal mediastinal tumors.

We are now in process of collecting all reports of cases, and the series will appear in a later publication. In 108 cases thus far assembled the tumors were classified as follows: primary tumors—chondrosarcoma (12 cases), osteochondroma (1 case), fibromyxoma (1 case), chondromyxoma (3 cases), dermoid cyst (1 case), endothelioma (2 cases), osteogenic sarcoma (29 cases) and spindle cell sarcoma (6 cases)—and metastatic tumors—carcinoma (21 cases), hyponephroma (8 cases), lymphoblastoma (10 cases), myeloma (2 cases) and melanosarcoma (1 case).

One of the earliest reports of an attempt to remove a tumor of the sternum was made by Holden[1] in 1878. In 1882 König[2] reported partial resection of the sternum for tumors in 2 cases. No attempt was made to close the bony defect. One patient lived for one year, and 1 died on the second postoperative day. Coupland and Gould[3] reported a case of sarcoma of the sternum in 1893. The neoplastic tissue was removed with a curet and the posterior aspect of the periosteum of the sternum left intact. In 1932 Heuer[4] reviewed the literature and

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Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 6, 1947.

1. Holden, J. S.: Sarcoma of the Sternum, Brit. M.J. **2**:358, 1878.

2. König, F.: Resektion des Brustbeins wegen eines Osteiodchonrom; Heilung, Centralbl. f. Chir. **9**:681-685, 1882.

3. Coupland and Gould: Sarcoma of Sternum: Consolidation of Left Lung (Secondary Deposits), Middlesex Hosp. Rep., 1893, p. 87.

4. Heuer, G. J.: The Tumors of the Sternum, Ann. Surg. **46**:830-842, 1932.

found 38 cases of tumors of the sternum; about 50 per cent were described as types of sarcoma.

Many of the tumors which arise in the sternum and costal cartilages are benign, or relatively so, and are curable by wide resection. In the majority of the reported cases the tumors had grown to considerable size, necessitating resection of all or most of the sternum and much of the attached cartilages.

This results in a major break in the continuity of the rigid thoracic cage, and, because of this and the site of the break, the operation invokes certain special serious problems in the physiologic aspects of respiration and in cardiac function. Following operation the restriction of excursion of the chest and the decided reduction of its effectiveness as a result of paradoxic movement profoundly embarrass respiration, often to an alarming degree. The embarrassment is much greater than that from similar defects elsewhere in the thoracic wall, because it involves both sides of the chest and because, the sternum being subcutaneous, there remains only skin to cover and support the defect. Elsewhere there is much support from overlying muscles and the shoulder girdle, and this lessens paradoxic movement. The heart, deprived of its bony protection, suffers with each inspiratory effort, not only from compression from retraction of the soft tissues covering it but also much of the functional aid contributed normally by negative intrathoracic pressure. A delicate pressure relationship exists between the pressure without and within the vena cavae and auricles, and movement of blood through the cavae and filling of the right auricle is dependent to some extent on the aspirating effect of negative pressure. As a result of cardiorespiratory embarrassment, early postoperative death has occurred in several reported cases. As time goes by, following operation, fibrous tissue infiltrates the precordial defect and contributes considerable rigidity, but presumably most patients are permanently more or less handicapped.

Efforts to eliminate this hazardous and disabling sequela have been directed toward reenforcing the defect.[4a] Heuer and others have mobilized the pectoral muscles and sutured them together in the midline. Recently, Watson and James[5] reported the use of a sheet of fascia lata to bridge the defect. At the last meeting of the Central Surgical Association, Griswold[6] reported a case in which the defect was closed with a tantalum plate. A persistently draining sinus necessitated re-

4a. Parlavecchio, G.: Metodo perlle resezioni osteoplastiche e definitive, parziali e totali, dello sterno, Cultura med. mod. **2**:417-430, 1924.

5. Watson, W. L. and James, A. G.: Fascia Lata Grafts for Chest Wall Defects, J. Thoracic Surg. **16**:399-406, 1947.

6. Griswold, A.: Osteochondrosarcoma of the Sternum: Use of a Tantalum Plate as a Tempory Prosthesis, to be published.

moval of the plate several weeks later, but by that time there had developed much rigidity from fibrous tissue.

Recently, we were confronted with this problem, and, since we utilized a method for which we find no precedent, a report of the operation seemed justifiable. As diagramed in figure 3, a segment

Fig. 1.—Lateral view of the sternum, showing bone destruction and a large subcutaneous mass protruding from the anterior surface and a smaller one projecting from the posterior surface into the mediastinum.

of the right seventh rib was removed in a length approximately 1 inch (about 2.5 cm.) more than the width of the resected specimen, consisting of the sternum and portions of the attached costal cartilages. The rib was split longitudinally and peg ends fashioned on both ends of both split segments. Cores were then cut from the stumps of the

right and left third and fourth costal cartilages, and, as the chest was sprung apart, the ribs were insinuated between the corresponding cartilage stumps, the pointed rib ends mortising firmly into the holes in the cartilages. The grafts were securely gripped as distraction was released and the two sides of the chest permitted to spring back medialward. To give additional anchorage to the grafts, the ends were

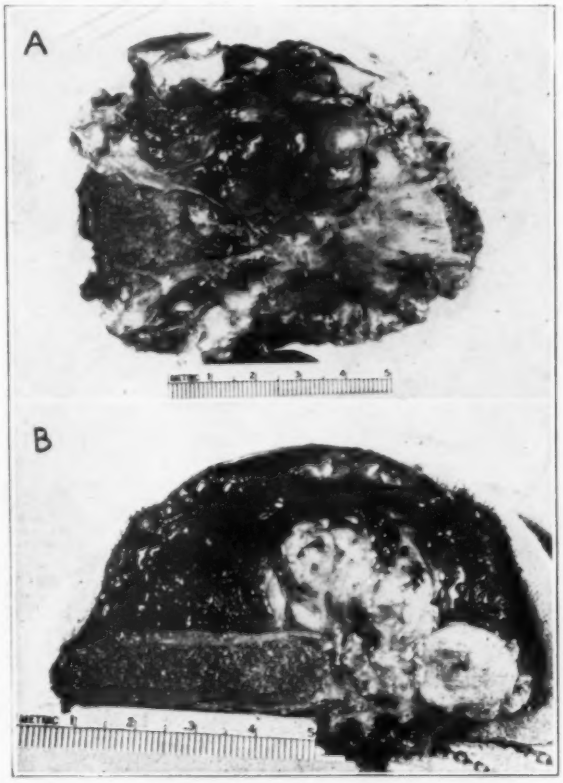

Fig. 2.—*A*, the resected sternum and attached third, fourth and fifth costal cartilages, as viewed from the mediastinal surface, with the protruding tumor mass. *B*, the sternum cut across through the tumor, showing the area of complete destruction of bone.

lashed to the cartilages with encircling sutures of surgical gut. The repair was completed by approximating the pectoral muscles and skin. The grafts at the time of the last observation, six months after operation, had remained fixed and unchanged, as judged by both palpation and roentgenographic examination. At no time following operation were there any retraction, paradoxic motion or embarrassment of respiration. The precordial area had normal contour and bony rigidity, and the chest moved normally.

This operation not only provided rigid support across the defect but also reestablished bony continuity to the thoracic cage. Also, there was the obvious advantage in the use of autogenous bone as compared with foreign material, such as "vitallium."

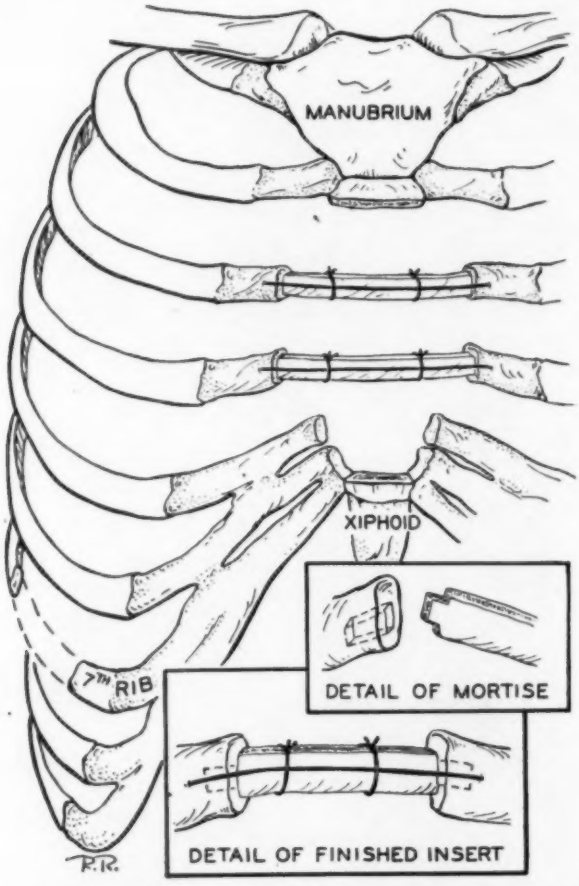

Fig. 3.—A diagrammatic illustration of the operation used to bridge the precordial defect remaining after resection of the sternum, showing the device for mortising and anchoring the grafted ribs and the manner in which these struts reestablish bony continuity to the thoracic cage.

To bridge defects larger than occurred in our case, two or more ribs could be utilized. If this should seem undesirable, bone could be obtained elsewhere, as from the crest of the ileum.

REPORT OF A CASE

Mr. E. S., aged 22 years, entered the hospital March 21, 1947, complaining of a small lump on the sternum. This lump was first noticed about one year previously, and its appearance was not related to any known trauma or disease. The

mass was about 1 cm. in diameter when it was discovered, but during the past year it had increased in size to a diameter of 3 by 6 cm. At no time had there been any pain or discomfort.

The patient was first seen by his local physician, who, in September 1946, made a small incision over the tumor and removed a piece of tissue for biopsy. Unfortunately, the tissue was lost. There was no further progress in the mass until January 1947, when again it began to increase in size rapidly. The patient was studied by Dr. R. D. Schrock, who made a diagnosis of neoplasm of bone, probably osteogenic sarcoma, and referred the patient for resection of the sternum.

On entrance to the hospital on March 21, physical examination was essentially without significant observations except for those of the sternal region. There was

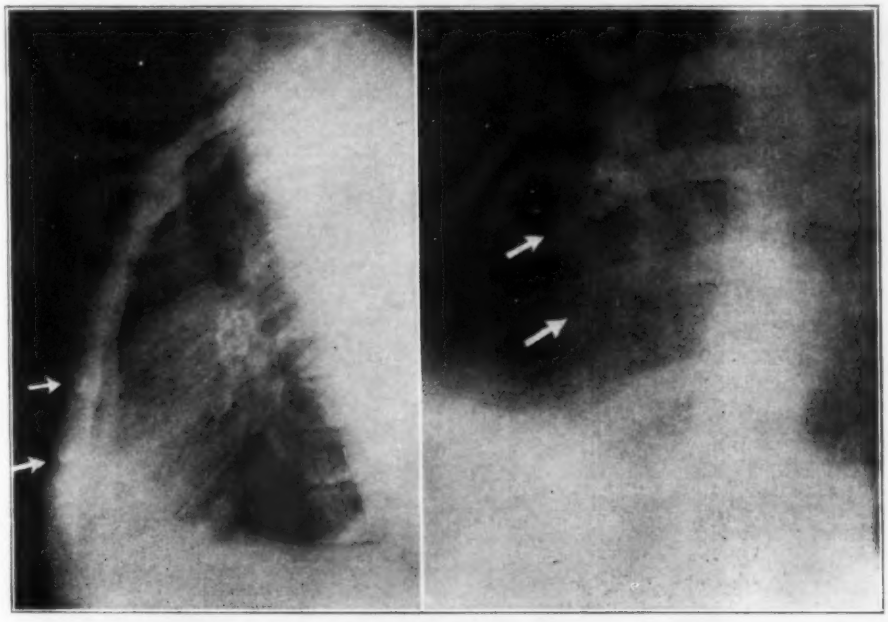

Fig. 4.—Lateral and oblique projections following operation, showing end and side views of the grafts.

a well healed vertical surgical scar overlying the lower third of the sternum. Beneath this scar, and extending over the anterior surface of the gladiolus of the sternum, was a tumor mass, measuring 6 cm. in diameter. This mass was continuous with the substance of the sternum, firm at the periphery, soft and fluctuant at the center and somewhat fixed to the overlying skin. There was no tenderness.

The urine was normal on admission, the Mazzini reaction of the blood was negative, and the blood cell count showed hemoglobin 14.3 Gm., white blood cells 9,300, staff cells 7 per cent, segmented forms 63 per cent, lymphocytes 23 per cent, monocytes 1 per cent and eosinophils 6 per cent. Roentgenograms (Schrock, Johnson and Waters) revealed a destructive lesion of the body of the sternum, with masses of soft tissue and bony density protruding both anteriorly and posteriorly from the respective surfaces of the sternum (fig. 1).

Operation was performed on March 22, under endotracheal anesthesia of cyclopropane supplemented with curare (40 mg.). A midline vertical incision was made, excising the previous scar of biopsy. Cutaneous flaps were raised; dissection was carried laterally on both sides to the middle portion of the costal cartilages, and the third, fourth and fifth ribs were cut through. The posterior cortical surface of the sternum was dissected free from the pericardium, and the gladiolus was cut across about 0.5 cm. distal to its articulation with the manubrium. The internal mammary vessels were picked up and ligated. Inferiorly, the gladiolus was cut across at its articulation with the xiphoid process, completely removing the portion of the sternum involved by the tumor. The pericardial and pleural cavities were not entered. Repair of the sternal defect and closure were then carried out as described earlier in this paper.

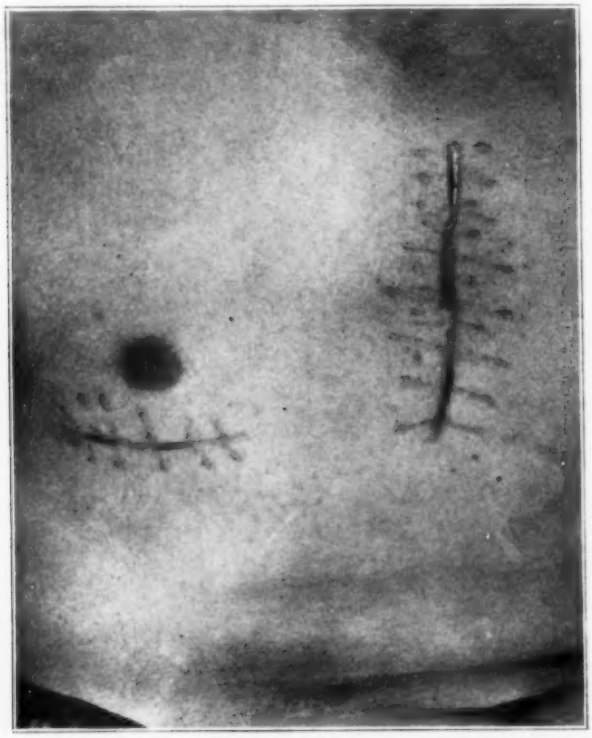

Fig. 5.—A photograph of the chest six months following operation, showing the wounds from which were resected the sternum and the segment of the right seventh rib used as grafts across the precordial defect. The absence of depression at the site of the precordial scar is apparent.

The patient had an uneventful convalescence and was discharged from the hospital on the eleventh postoperative day. Microscopic examination of the tumor revealed a highly undifferentiated round cell sarcoma, probably of bony origin.

Reexamination, six months after operation, revealed, as stated previously, a normally rigid thoracic wall, with no retraction and no paradoxic respiratory motion over the precordial region. Roentgenograms showed union between rib grafts and the corresponding stumps of the costal cartilages, with no displacement. There

was no evidence of metastases to the lung, nor was there any other evidence of recurrence. The patient looked and felt well and was doing full time work.

SUMMARY

Although indications for excision of a part or all of the sternum and costal cartilages are rare, the postoperative complications of paradoxic respiratory motion in precordial defect and cardiorespiratory embarrassment are sufficient hazards and sufficiently disabling to provoke interest in an operative technic which will obviate its occurrence.

A technic utilizing split rib grafts to bridge the defect between the stumps of the costal cartilages is presented.

A case of undifferentiated round cell sarcoma of the sternum with excision of the gladiolus and adjoining costal cartilages, in which the described operation was utilized, is reported.

DISCUSSION

DR. ROBERT D. SCHROCK, Omaha: The patient described by Dr. Bisgard came to my associates and me nine months after discovery of his sternal tumor and six months after biopsy had been done. Apparently the study of the tissue removed was not satisfactory. We were unable to obtain the specimen for study. The tumor had in the past three months increased in size, as observed by the patient; also, there was evidently extensive destruction of bone. For these reasons, the tumor was regarded as malignant.

Bone tumors have been, over a period of time, one of our "playgrounds," and a certain plan of action has been developed in arriving at a decision for treatment in each problem. The radiologist familiar with the problem of bone tumors is an essential consultant. The pathologist, for evaluation of the biopsy specimen, or frozen section, at the time of operation is the valuable "third party."

In general, we follow a plan of preliminary radiation with roentgen ray. When the bone tumor is in an extremity and its characteristics indicate amputation, tissue-mordant doses are given, while the area through which the amputation is to be done is carefully protected. In these cases in which local resection of a bone, or a portion of bone, is indicated, irradiation with roentgen rays is limited to inhibiting doses if the tumor is regarded as sensitive to radiation. Local resection must be carried through tissues that still present circulation adequate for healng.

For this particular patient, the radiologist (Dr. H. B. Hunt) advised against preoperative irradiation with roentgen rays, for the reason that irradiation of the sternum would tend to produce some occlusion of the smaller vessels in the anterior mediastinum and might have, also, a fibrosing effect on the coronary circulation. For the same reasons, postoperative irradiation was regarded as unwise.

The tumor was located in a resectable bone. Detailed study of the patient failed to demonstrate skeletal metastases. This was true, also, of the chest, as verified by both roentgenogram and fluoroscopic examination.

Having reached the decision that the sternum should be resected, this question arose, "Are there hands more skilled than ours to carry through the technical procedures?" Here is a situation in which the technic is necessarily the technic of men familiar with thoracic surgical treatment, so that properly we step out of the operative picture. Dr. Bisgard's ingenuity in replacing the resected sternum with viable tissue is shown in his diagrams. It is highly commendable and, to the patient, of unrepayable value. The patient's convalescene was startlingly uneventful.

The pathologist's study of the tumor tissue is interesting. The terminology in bone tumors still depends much on individual viewpoint. This tumor now has two names: small round cell sarcoma of bone and hemangioendothelioma of bone. Clinically the classification must be osteosarcoma, lytic in type and malignant in quality.

The pathologist can always give the characteristics of tumor tissue, as to its degree of differentiation and his estimate of its malignancy. Dr. Henry Meyerding, in his long study of many bone tumors, has properly insisted that some gradation of malignancy is feasible by the pathologist and of value to the surgeon in his prognosis and plan of preoperative and postoperative care. This gradation has been pioneered by Dr. Broders, with his group of 1, 2, 3 and 4, in ascending degrees of malignancy.

There is in this case also the problem of compensation insurance. For a long time the patient used a pneumatic hammer and has had repeated blows on his sternal region. The medicolegal question arises, "Is trauma, single or repeated, a causative factor in the production or aggravation of this tumor?"

DR. THOMAS J. KINSELLA, Minneapolis: Dr. Bisgard has used an ingenious method for the reconstruction of the sternal defect. My associates and I have met this problem in three different ways:

The first method is illustrated by the case of a 60 year old man presenting a large tumor of the manubrium, which had been growing for a period of two years and was interfering considerably with depressing his chin and wearing a collar. The tumor mass involved the whole manubrium, the upper 2 cm. of the gladiolus, the inner third of both clavicles and the cartilages of the first and second ribs. It proved to be an apparently solitary myeloma.

It was deemed inadvisable in this elderly man with hypertension to carry out a prolonged procedure, so that, since the defect was not large, no reconstruction was done. It would have been a simple procedure to insert rib graft between the first and second cartilages. This man has no handicap from the defect or from loss of stability of the clavicles. In a younger person, I believe that reconstruction of some type could have been done.

The second method is illustrated by the case of a man of 30, in whom a large tumor of the sternum developed soon after he was struck on the chest by a batted ball. He had a benign giant cell tumor of the sternum, for which resection of the entire gladiolus and lower half of the manubrium was done. Reconstruction was carried out by tibial bone grafts placed in the form of a ladder, with two cross rungs sutured to the costal cartilages on each side. Bone chips from the rib and the tibia were inserted between the grafts. This man had a stable chest from the time of operation. He was a chronic cigaret smoker and had much secretion, but he was able to cough and raise sputum without difficulty. The result has been good. Three and a half years later, there is a stable thoracic wall, without deformity.

A third method which could have been used is one which we have employed for reconstruction of the thoracic wall following resection of other tumors of the thoracic wall. The man for whom this method was employed had a large osteochondrosarcoma, the removal of which, with large portions of three ribs and cartilages, left a large defect of the thoracic wall. This was bridged with a large fascia lata graft placed under slight tension and by split rib grafts in lattice work. This gave a stable thoracic wall, without paradoxic motion, which has enabled him to swing a shovel as a locomotive fireman without difficulty. The same method may be used to stabilize the defect created by resection of the sternum.

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VOLUME OF THE BLOOD IN PATIENTS WITH TOXIC GOITER

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AND

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INCREASED cellular metabolism with excessive catabolism of body protein and loss of weight is a basic factor in the pathophysiologic aspects of hyperthyroidism. In patients with hyperthyroidism gain of weight signifies clinical improvement. Failure to gain weight during the period of preoperative preparation is associated with increased operatve morbidity and mortalty.[1]

Attention has recently been directed to the significance of hemoglobin deficiency in the depletion of protein associated with loss of weight in many types of chronic illness.[2] In such progressive depletion of protein the deficit in the total mass of circulating red blood cells may be masked by a constriction of the volume of plasma and can be determined only by studies of the volume of blood. The routine laboratory procedures of determinations of hematocrit percentage, red blood cell counts and determinations of hemoglobin are frequently inadequate in determining the true degree of anemia in debilitated patients.[3]

Whipple and his co-workers have shown that when there is a deficiency of tissue, plasma protein and hemoglobin, ingested protein

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Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 4, 1947.

1. Ravdin, I. S.: Protein Deficiency in Surgical Patients, S. Clin. North America **26**:1306-1318 (Dec.) 1946.

2. (*a*) Clark, J. H.; Nelson, W.; Lyons, C.; Mayerson, H. S., and DeCamp, P.: Chronic Schock: The Problem of Reduced Blood Volume in the Chronically Ill Patient, Ann. Surg. **125**:618-646 (May) 1947. (*b*) Lyons, C., and Mayerson, H. S.: The Surgical Significance of Hemoglobin Deficiency in Protein Depletion, J. A. M. A. **135**:9-11 (Sept. 6) 1947.

3. Clark and others.[2a] Lyons and Mayerson.[2b] Lyons, C.: Penicillin Therapy of Surgical Infections in the U.S. Army: Report, J. A. M. A. **123**:1007-1018 (Dec. 18) 1943. Evans, E. I.: Significance of Blood Volume Alterations in Surgical Patients, South M. J. **38**:214-221 (March) 1945.

is utilized principally for the fabrication of hemoglobin.[4] Replenishment of tissue protein, with resulting gain of weight, does not readily occur in the presence of a deficit in total circulating hemoglobin. Regeneration of tissue protein in the absence of anemia is accomplished rapidly when the intake of protein is adequate.[5]

For the clinical application of studies of the volume of blood, some table of standard values must be available for comparison.[6] In patients with loss of weight it has been demonstrated that the functional capacity of the vascular reservoir is not significantly diminished;[2a] therefore, in debilitated patients the standard values for the volume of circulating blood should be calculated on the basis of the usual weight in health, rather than on the basis of surface area or observed weight in illness.[2] Substantial evidence has been presented that obviously malnourished patients may have values near assumed standard for usual weight, whereas determinations following whole blood transfusions to the point of optimal clinical benefit have shown restoration of the standard volumes of circulating blood for optimal weight. It is possible to restore the volume of blood to standard for the usual weight in health by repeated blood transfusions without producing significant hemoconcentration. Especially significant is the fact that during convalescence from disease associated with loss of weight and diminished volume of blood the volumes of circulating plasma and total red blood cells are restored to standard for usual weight in health prior to significant gain in weight.[2a]

Chong[7] and Gibson and Harris[8] have reported volumes of circulating blood greater than the expected standard in patients with hyperthyroidism. Their estimations of standard values were based on the patient's surface area, calculated with the DuBois formula from observed height and weight. Gibson and Harris observed values only 5 per cent above standard on the basis of observed height and weight.

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4. Whipple, G. H., and Madden, S. C.: Hemoglobin, Plasma Protein, and Cell Protein: Their Interchange and Construction in Emergencies, Medicine **23**:215-224 (Sept.) 1944.

5. CoTui; Bartter, F. C.; Wright, A. W., and Holt, R. B.: Red Cell Reinfusion and Frequency of Plasma Donations: Preliminary Report of Multiple Donations in Eight Weeks by Each of Six Donors, J. A. M. A. **124**:331-336 (Feb. 5) 1944.

6. (*a*) Footnote 3. (*b*) Whipple and Madden[4] (*c*) CoTui and others.[5] (*d*) Gregersen, M. I.: A Practical Method for the Determinations of Blood Volume with the Dye T-1824, J. Lab. & Clin. Med. **29**:1266-1286 (Dec.) 1944.

7. Chong, H. C.: The Blood Volume in Hyperthyroidism, J. Clin. Investigation **10**:475-487 (April) 1931.

8. Gibson, J. G., II, and Harris, A. W.: Clinical Studies of the Blood Volume: V. Hyperthyroidism and Myxedema, J. Clin. Investigation **18**:59-65 (Jan.) 1939.

Obviously, the patients studied by them would have shown deficits if calculations had been made on the basis of optimal weight in health.

The purpose of this paper is to present observations on the volumes of plasma, total circulating red blood cells and total circulating plasma proteins in patients with toxic goiter prior to treatment and during convalescence. Comparison of values in patients with toxic and nontoxic goiters will be presented. The value of preoperative transfusions for the occasional patient who fails to improve during routine preoperative treatment will be discussed.

CLINICAL OBSERVATIONS

Repeated studies of the volume of blood were made in 7 patients with primary hyperplastic goiter and in 6 patients with nontoxic goiter. Determinations of volume were performed by the plasma-dye-hematocrit method of Gregersen,[6d] as previously outlined. (Volume of blood equals volume of plasma times 100 divided by 100 minus the hematocrit value.[2a]) The volumes of red blood cells were calculated from hematocrit values obtained after centrifuging heparinized blood for thirty minutes at 3,000 revolutions per minute in Wintrobe tubes. The percentage of hemoglobin grams was calculated by the method of Evelyn.[9] The specific gravity of plasma was determined by the falling drop method of Barbour and Hamilton[10] and protein concentration in the plasma by the formula of Weech, Reeves and Goettsch.[11] Occasional determinations of hematocrit and protein in the plasma were done using the copper sulfate specific gravity technic.[12] This method has been repeatedly checked during the past three years and found to be accurate. The values given by Gregersen[6d] were used to assign standard levels for the volume of blood, plasma and red blood cells, total grams of circulating plasma protein and total grams of circulating hemoglobin. Gregersen's normograms were assembled from a large series and agree in general with other series.[2a]

In the patients with nontoxic goiter, the volume of plasma varied from 44.5 to 46 cc. per kilogram and the total volume of circulating

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9. Evelyn, K. A.: Stabilized Photoelectric Colorimeter with Light Filters, J. Biol. Chem. **115**:63-75 (Aug.) 1936.

10. Barbourf, H. G., and Hamilton, W. F.: The Falling Drop Method for Determining Specific Gravity, J. Biol. Chem. **69**:625-640 (Aug.) 1926.

11. Weech, A. A.; Reeves, E. B., and Goettsch, E.: The Relationship Between Specific Gravity and Protein Content in Plasma, Serum and Transudate from Dogs, J. Biol. Chem. **113**:167-174 (Feb.) 1936.

12. Phillips, R. A., and others: Copper Sulphate Method for Measuring Specific Gravities of Whole Blood and Plasma, New York, Josiah Macy, Jr. Foundation, 1945.

blood between 81 and 85 cc. per kilogram, values within the range of accepted standard.[6]

The average values for the patients with preliminary hyperplastic goiter are compared with values previously reported for patients with loss of weight from various causes[2a] in table 1. In patients with hyperthyroidism, as in patients with loss of weight from other causes, the deficit for total volume of circulating blood is approximately one fourth of the value accepted as standard for the patient in health. The

TABLE 1.—*Tabulation of Blood Volume Deficits Associated with Weight Loss*

Disease	No. of Cases	Percentage of Standard for Usual Weight					
		Weight	Total Hemoglobin	Total Cell Volume	Total Plasma Protein	Plasma Volume	Blood Volume
Malignant growth	41	83	50	58	87	84	72
Chronic infection	28	87	59	59	....	92	76
Hepatic disease	8	84	52	56	82	84	67
Malnutrition	7	78	53	61	89	91	76
Peptic ulceration	5	85	66	70	92	88	79
Hyperthyroidism	7	84	71	71	87	87	77

*Values for malignant conditions, chronic infection, hepatic disease, malnutrition and peptic ulceration were reported by Clark and his associates.[2a]

reduction in total hemoglobin and red blood cell mass is more pronounced than the reduction in total plasma protein or plasma volume.

REPORT OF CASES

CASE 1.—R. R., a 32 year old man, had been ill for seven months prior to study. During this period he had lost 30 pounds (about 13.7 Kg.). On admission his total volume of circulating red blood cells was 79 per cent of standard and his volume of circulating blood 91 per cent of standard (table 2). After one week of treatment with iodine, sedatives and a diet high in calories and proteins, his total volume of red blood cells was 85 per cent of standard, an increase of 225 cc. His volume of plasma had decreased, so that the calculated total volume of circulating blood was 87 per cent of standard, the usual response to complete rest in bed.[13] Two weeks following thyroidectomy the total volume of circulating red blood cells was 2,340 cc., 69 per cent of expected standard, and the volume of circulating blood 5,200 cc., 71 per cent of expected standard. This decrease is the result of surgical loss of blood, which averages 379 cc. for thyroidectomy,[14] and the decreased intake of food during the immediate postoperative period. Five weeks after thyroidectomy he had 1,063 Gm. of hemoglobin, 96 per cent of standard; 256 Gm. of circulating plasma protein, 104 per cent of standard; a volume of plasma of 3,770 cc., 99 per cent of standard; a total volume of red blood cells

13. Taylor, H. L.; Erickson, L.; Henschel, A., and Keys, A.: The Effects of Bed Rest on the Blood Volume of Normal Young Men, Am. J. Physiol. **144**:227-232 (July) 1945.

14. Coller, F. A.; Crook, C., and Iob, V.: Blood Loss in Surgical Operations, J. A. M. A. **126**:1-5 (Sept. 2) 1944.

of 3,180 cc., 91 per cent of standard, and a total volume of circulating blood of 6,950 cc., 94 per cent of standard. This increase of volume of circulating blood to approximately standard values for his usual weight of 190 pounds (about 86.4 Kg.) occurred prior to significant gain in weight and persisted throughout convalescence.

CASE 2.—J. T., a 27 year old veteran, had been ill for twelve months. In the four months prior to admission he had become extremely nervous and had lost 35 pounds (about 15.9 Kg.), although his appetite had been good. On June 1, 1947, he consulted a physician who observed his basal metabolic rate to be + 44 per cent and prescribed iodine tablets, which he took daily for six weeks. On

TABLE 2.—*Data in Case 1*

Date	Comment	Total Circulating Plasma Protein (Gm.)	Total Cell Volume (Cc.)	Blood Volume (Cc.)	Body Weight (Kg.)
7/22/47	On admission (iodine and high protein diet started	204	2,675	6,666	72.7
7/29/47	Thyroidectomy	218	2,900	6,400	72.7
8/13/47	After discharge	150	2,340	5,200	73.2
9/ 3/47	Working	256	3,180	6,950	75
11/14/47		249	3,160	7,025	78.2
	Standard for usual weight	245	3,400	7,350	86.4

TABLE 3.—*Data in Case 2*

Date	Comment	Pulse Rate	Basal Metabolic Rate	Total Cell Volume (Cc.)	Blood Volume (Cc.)	Body Weight (Kg.)
8/11/47	Iodine fast. No improvement on diet high in proteins and sedatives	120	+19	2,550	5,200	60.9
8/13/47		124	+27	—	—	—
8/24/47	500 cc. of blood on 8/20 and 8/21	80	+ 5	3,270	6,055	61.6
8/27/47	Decided clinical improvement	72	+ 7	—	—	—
8/29/47	Thyroidectomy	76	—	2,795	5,590	62.5
9/27/47	Symptom free, teaching school	72	—	2,680	5,825	64.5
	Standard for usual weight			2,975	6,425	76.4

August 8 he was admitted to the Veterans' Administration Hospital in Salt Lake City. He failed to show clinical improvement with routine preoperative treatment, consisting of bed rest, sedatives, a diet high in calories and proteins and strong solution of iodine U.S.P. On August 11 his total circulating plasma protein was 160 Gm., 73 per cent of standard; volume of plasma 2,650 cc., 77 per cent of standard; volume of red blood cells 2,550 cc., 86 per cent of standard, and volume of circulating blood 5,200 cc., 81 per cent of standard (table 3). Between August 11 and August 20, his basal metabolic rate varied between + 19 and + 27 per cent and his pulse rate between 100 and 120 and he failed to gain weight. He was given 500 cc. of blood on August 20 and 500 cc. on August 21, with immediate clinical improvement. Studies of the volume of blood on August 24 showed values

near standard levels for his usual weight in health. His pulse rate was 80 and basal metabolic rate + 5 per cent, and he showed gain in weight for the first time since the onset of his illness. On August 29 a thyroidectomy, using the Lindem "off-the-trachea technic,"[15] was well tolerated. One month following operation he had returned to his civilian occupation of teaching, was gaining weight and felt normal in every respect. Studies of the volume of blood at this time showed a total volume of protein in the plasma of 204 Gm., 93 per cent of expected standard; a volume of plasma of 3,145 cc., 91 per cent of standard; a volume of red blood cells of 2,680 cc., 90 per cent of standard, and a volume of blood of 5,825 cc., 91 per cent of standard for his usual weight in health. These values are sufficiently higher than standard values for his observed weight of 142 pounds (about 64.5 Kg.).

CASE 3.—D. B., a 19 year old girl, experienced symptoms of hyperthyroidism three and a half months prior to study. The data in this case appear in table 4.

COMMENT

These studies indicate that in protein depletion resulting from hyperthyroidism, as in other types of protein depletion, there is a decrease in the volume of circulating blood. The major deficit is in

TABLE 4.—*Data in Case 3*

Date	Comment	Total Plasma Protein (Gm.)	Total Cell Volume (Cc.)	Blood Volume (Cc.)	Body Weight (Kg.)
8/22/47	Thyroidectomy	164	1,400	3,680	54.5
11/15/47	Uneventful convalescence	167	2,035	4,616	55.2
	Standard for usual weight	169	2,340	4,850	57.7

hemoglobin, as reflected by the greater decrease in total volume of red blood cells than in volume of plasma (tables 1, 2, 3 and 4). These changes are essentially the same as reported in loss of weight from various types of illness not associated with loss of blood and in malnutrition. That the increased metabolic rate resulting from hyperthyroidism is the causative factor is evidenced by the observation of standard volumes of blood in patients with nontoxic goiter.

Following thyroidectomy there is a progressive increase in the volume of circulating blood. The restoration of the volume of plasma and total volume of red blood cells to near standard for usual weight in health occurs prior to significant gain in weight, as illustrated in tables 2 and 4. This is additional evidence that the vascular reservoir remains fairly constant during loss of weight and that the standard values for volume of blood in patients with loss of weight should be calculated on the basis of usual weight in health.

15. Lindem, M. C.: Subtotal Thyroidectomy for Toxic Goitre by the Off-the-Trachea Method, Tr. West. S. A. **52**:150-160, 1944.

The value of preoperative transfusion therapy in hyperthyroidism is shown in table 3. The patient did not improve with routine treatment, but did show immediate subjective and objective improvement when his hemoglobin deficit was corrected by whole blood transfusions. We do not suggest that every patient with toxic goiter will require preoperative blood transfusions, but the occasional patient who fails to respond to routine treatment will be a better operative risk following restoration of total circulating hemoglobin to standard. It is suggested that in the patient with hyperthyroidism correction of hemoglobin deficit by whole blood transfusion spares ingested protein for the synthesis of tissue protein. This results in subjective clinical improvement and gain in weight.

SUMMARY

In protein depletion resulting from hyperthyroidism there is a decrease in the volume of circulating blood, particularly in the total volume of red blood cells.

During convalescence following the removal of a hyperplastic goiter and prior to significant gain in weight there is a progressive increase in the volume of circulating blood.

Patients with hyperthyroidism who fail to respond to routine preoperative treatment are better operative risks following correction of hemoglobin deficits with whole blood transfusions.

USE OF PROPYLTHIOURACIL IN THE TREATMENT OF TOXIC GOITER

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FOR THE first time in the history of surgical treatment of the thyroid, it is now possible to operate on all types of toxic goiter with comparatively little risk. While effective in the preoperative and postoperative care of exophthalmic goiter, iodine has not been effective in lowering the operative risk in cases of advanced toxic adenoma. Thiouracil and propylthiouracil (thiourea derivatives), on the contrary, are extremely beneficial in preparing both exophthalmic goiter and toxic adenoma for operation. Thiouracil, because of its tendency to cause toxic reactions and, especially, granulocytopenia, has been largely abandoned for the much safer propylthiouracil.

From a study of 170 cases of hyperthyroidism in which treatment was with propylthiouracil during the past two years, some conclusions have been reached.

1. After several months' treatment, patients with advanced multiple toxic adenoma with a serious cardiovascular condition may be operated on with almost as little risk as patients with nontoxic disease.

2. Diabetes and other complications of toxic adenoma no longer impose a serious problem. Even senility is not a contraindication to surgical treatment.

3. Since there is little material change in the gland itself, thyroidectomy must be performed in all cases of adenomatous goiter to effect a cure.

4. Propylthiouracil may prove to effect a cure in certain early cases of exophthalmic goiter in which treatment is continued one or more years. Results in my experience to date are disappointing. In a series of 41 cases in which treatment was continued from six to eighteen months, there was recurrence of symptoms in all but 2 cases when treatment with the drug was stopped for a few months.

From the Jackson Clinic.

Read at the annual meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 4, 1947.

5. It may be that longer periods of treatment or treatment with a certain combination of drugs will in time eliminate the necessity for thyroidectomy for exophthalmic goiter.

Fig. 1.—*A*, a 10 year old child with severe exophthalmic goiter. The basal metabolic rate was + 64 per cent and weight 83 pounds (37.6 Kg.). *B*, after seventeen months of treatment with thiouracil and propylthiouracil the basal metabolic rate was + 23 per cent, the weight was 95 pounds (43.1 Kg.) and the health good. *C*, fourteen months after treatment with propylthiouracil was discontinued, the basal metabolic rate was + 22 per cent, weight 104 pounds (47.2 Kg.) and health good.

Fig. 2.—Post-thyroidectomy recurrence of exophthalmic goiter in a 13 year old girl controlled by treatment with propylthiouracil. Thyroidectomy revealed a large right lobe not affected by the drug.

6. While a discussion of the use of radioactive iodine is not within the scope of this paper, there is considerable promise that in time this substance will be the answer to this problem.

7. Propylthiouracil is beneficial in treatment in certain unusual cases of exophthalmic goiter in which the risk of operation is increased, such as in the iodine-fast type, in cases of the disease in children, in the aged, in pregnant women and in instances in which hyperthyroidism has been active a long time. Because of certain conditions, it may be desirable or necessary to delay operation some months.

Fig. 3.—*A*, severe exophthalmic goiter in a 14 year old girl. The basal metabolic rate was + 54 per cent, the pulse rate 117 and weight 114½ pounds (51.9 Kg.). The gland was large. *B*, seven months after treatment with propylthiouracil there was no change in the size of the gland, the basal metabolic rate was + 14 per cent, pulse rate 84 and weight 141½ pounds (64.2 Kg.). *C*, thyroidectomy was performed to effect a cure.

Fig. 4.—*A*, multiple toxic adenoma complicated by cardiovascular disease, diabetes and albumin in the urine (4 plus). The basal metabolic rate was + 64 per cent. *B*, the same patient after thyroidectomy. She had been treated for two months prior to operation with propylthiouracil. She made an uneventful recovery.

Before these new drugs were introduced, it was not possible to do this without entailing great risk to the patient.

8. *Dosage.*—As yet there is no general agreement on the amount of propylthiouracil to be given either as to dosage or the duration of treatment. The majority of patients in this series received 50 mg. of the drug before each meal. When the toxic symptoms have largely

subsided and when the basal metabolic rate has approached normal, the patient should be in condition for thyroidectomy. The length of preparation required will vary with such factors as the patient's age,

Fig. 5.—*A*, advanced toxic adenoma. The basal metabolic rate was + 68 per cent. with decompensation and auricular fibrillation. The patient was prepared for operation by treatment with propylthiouracil. *B*, the same patient six months after operation. She had made a good recovery, with cardiac compensation and regularity.

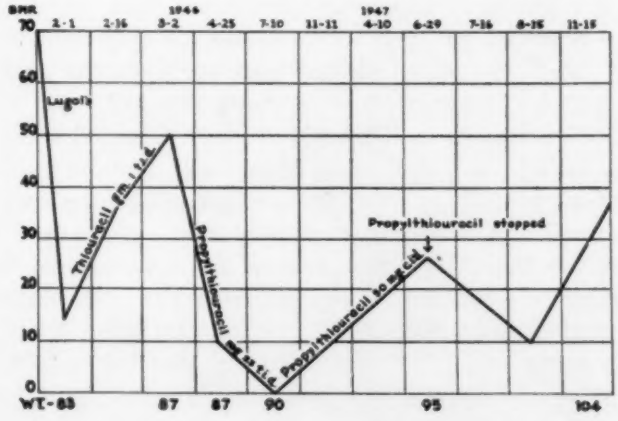

Fig. 6.—Chart showing the effect of treatment with thiouracil and propylthiouracil on the metabolic rate and the weight.

the severity of the disease, the type of goiter, the duration of symptoms and the cooperation of the patient. If the patient drinks six cups of coffee and smokes a package of cigarets a day, he must find an-

other surgeon as far as I am concerned, because, if he continues such habits, he will not recover his health regardless of what is done for him.

9. *Disadvantages.*—The vascularity of the gland is greatly increased by the use of this drug, and operation is consequently technically more difficult. This may be avoided by giving iodine from the start or by stopping the drug ten days prior to operation and substituting iodine, as done in this study. Since it apparently is an aid and not a cure for exophthalmic goiter, the drug is no longer used in preoperative preparation in the average case. The majority of patients now receive preoperative and postoperative treatment, as in the past, with iodine.

10. Cases of persistent and recurrent exophthalmic goiter still occur in the experience of every surgeon interested in surgical treatment for the thyroid. Some of the patients recover if nothing is done, others if given treatment with roentgen rays and still others if given iodine. Now propylthiouracil effectively controls the disease and may return the metabolic rate to normal, but it does not cause the gland to diminish, and sooner or later in most instances operation will be again required.

11. *Reactions.*—When those of us who were doing the clinical research studies in these cases compared our data, granulocytopenia was observed to have occurred in only 1 case in approximately 2,000 cases of toxic goiter in which treatment was with propylthiouracil. In the case reported on by Bartels,[1] of the Lahey group, the patient recovered. This is in decided contrast with results in the large number of cases in which granulocytopenia developed following the use of thiouracil. Eisenmenger and Steele[2] recently reported a case of leukopenia following the use of propylthiouracil. However, this patient received thiouracil for a considerable period before being given propylthiouracil. Nevertheless, caution should be observed when administering the drug. The first year, a white blood cell count was required every two weeks; now this period has been extended to four weeks. In only 1 case, that of a 7 year old child suffering with exophthalmic goiter, did the blood cell count fall below 5,000. A few instances of cutaneous reaction, vomiting, diarrhea and fever have been observed, but these have usually occurred when large doses of the drug have been given. No such complications occurred in this study.

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1. Bartels, E. C.: Personal communication to the author, Feb. 7, 1947.

2. Eisenmenger, W. J., and Steele, J. M.: Use of Propylthiouracil, J. A. M. A. **135**:510-511 (Oct. 25) 1947.

SUMMARY

Of the 170 patients, 109 had toxic adenomas and 61 had exophthalmic goiter. In the two groups, one stage thyroidectomy was performed in 141 cases, with no deaths and no serious complications except 1 nonfatal case of postoperative hemorrhage and 1 in which there was infection. Twenty-nine patients are still receiving the drug and are under study, most of these being patients with exophthalmic goiter. For the sake of clinical investigation, some of these patients have now been receiving the drug for nearly two years.

I have been interested in the subject of goiter for nearly three decades, having worked in the days before and after hot water injections were used, in the days before and after ligation and iodine were introduced in treatment and in the days of crises and of multiple stage operations; it is a great satisfaction now to see the problem of toxic goiter nearly solved. Surgeons have not completely solved the enigma yet, but they are getting close to a solution. The day will come when surgical treatment will be entirely eliminated in effecting the cure of exophthalmic goiter.

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DISCUSSION

OF PAPERS BY DR. ARNOLD JACKSON AND DRS. JOHN CLARK AND MARTIN C. LINDEM

DR. WARREN H. COLE, Chicago: Dr. Jackson has already indicated the efficiency of propylthiouracil in reducing the basal metabolic rate to 0. All of us agree concerning its great efficiency. The only controversy about propylthiouracil now seems to be as to how often one can avoid operation by the use of the drug.

There are certain groups of patients in whom the probability of elimination of operation is notoriously poor. In my experience the patients with large glands, those with a toxic condition, those who have had the thyroid toxicity for a great length of time and those having cardiac decompensation along with thyroid toxicity are poor groups in which to attempt the use of propylthiouracil on the basis of medical treatment alone.

In my experience certain patients are more likely to have lasting remissions than others: (1) those with conditions that are mildly toxic, particularly if the toxicity is of recent origin, (2) those who have small glands and (3) those who had a recurrence of symptoms following operation.

I know that in the literature there are many reports indicating that propylthiouracil is not effective in eliminating the disease without operation, but I have had a few cases in which the remission has lasted two years or more. Dr. Jackson indicated that 1 or 2 of his patients with the recurrent type of disease appeared to be faring well on drug therapy alone.

In the series in which my associates and I attempted to treat toxic goiter with propylthiouracil alone we did have a greater percentage of lasting remissions than was reported by Dr. Jackson. In his series of 41 cases in which there was prolonged treatment with propylthiouracil, all except 2 patients had recurrence of symptoms

when the treatment was stopped. We have had a much higher percentage of lasting remissions than that. However, our group had been rather carefully picked. They were types which we thought might respond, the types I just mentioned.

I think that it is important to arrive at some conclusion about the time for operation. When one is treating a patient with propylthiouracil, when should one operate? Many physicians have expressed the belief that after the severe symptoms have been eliminated they can proceed with thyroidectomy, even though the basal metabolic rate may be 30 per cent above normal and there may be other evidence of toxicity, but I am convinced that mortality rates in a large series of cases will definitely be lower if the patients are not operated on until the basal metabolic rate has returned to normal. I would also like to emphasize that one should not overtreat these patients and produce hypothyroidism, because then the rate of mortality will likewise increase.

Dr. Jackson reported that there were no deaths of patients having thyroidectomy following treatment with propylthiouracil. I think that he had 170 such cases. We have had about 120 and likewise have no deaths. Throughout the country physicians are getting similar results. I think that that indicates clearly that there is a distinct improvement in the physiologic function when hyperthyroidism is obliterated. Numerous organs must be involved in that improvement. This low rate of mortality in cases in which thyroidectomy followed treatment with propylthiouracil is so definite that one cannot ignore it.

I agree with Dr. Jackson that treatment with propylthiouracil will not eliminate the necessity for operation; it will take another drug much more efficient and probably of a different type to do so.

DR. MARTIN C. LINDEM, Salt Lake City: It has been observed by my colleague and me and by others—notably by Rose and Ravdin—that if a patient suffering from hyperthyroidism fails to gain weight during the period of preoperative treatment, it may be of serious consequence, in that the morbidity and rate of mortality from operation are increased in such cases. Such a condition is the same as, or is akin to, hypoproteinemia in seriously debilitated persons, brought on by chronic loss of blood, inability to assimilate food by some alimentary pathologic condition or metabolic disorders of various sites of origin. This state of chronic malnutrition has been called chronic shock by Lyons and his co-workers.

Previous workers have stressed loss of protein, reflected by hypoproteinemia, as loss of tissue protein, without attributing such loss of protein as hemoglobin in the total cell mass of blood. This interpretation may be due to the usual methods of evaluating the status of blood in the body, namely, the red blood cell counts, hematocrit values or hemoglobin determinations, which have now been shown to be in error because of unexplained physiologic readjustments in debilitating disease. Our investigations show that a significant loss in total volume of blood exists in severe debility from primary hyperplastic thyroid disease, as well as nodular hyperplastic thyroid disease. There is no noticeable difference in this loss, even though the clinical symptoms are widely divergent. In primary hyperplasia rapid deterioration of skeletal muscle as well as of the principal organs occurs, while in nodular goiter with hyperthyroidism cardiovascular deterioration is predominant. The pathophysiologic aspects in the two different clinical conditions appear to be the same.

A rapid restitution to safe operability can be made by adequate replacement of blood by transfusion of whole blood. When surgical removal of the thyroid gland is contemplated for relief or cure, it becomes imperative in the preoperative management, on the basis of these studies, to give sufficient blood, duly calculated by accurate laboratory measurement of volume of blood. We are now

beginning correlation of the pretherapeutic state of patients suffering from hyperplastic thyroid disease, who are selected for treatment with thiourea derivatives. It can be argued that, preceding treatment with drugs, adequate replacement to normal volume of blood for optimum normal weight would have the same beneficial results.

Our experience in applying this experimental knowledge in the treatment of patients leads us to sound two warnings.

First, the coefficient of error residing with the average technician in the hospital or clinic laboratory is too great for accuracy. Syringes must be minutely calibrated; venipuncture must obviate leakage of dye or blood from the closed vascular system, and colorimetry must be without error. Peripheral veins in debilitated persons who exhibit great loss of blood are contracted and difficult to enter. Dye is therefore easily spilled, or recovery of the dyed sample is not adequate. A special technical staff is necessary before diagnostic laboratory data are acceptable.

Second, the transfusion of large quantities of blood into a person entails accurate typing, evaluation of allergic and Rh factors and reaction-free vehicles for transferring the blood. Morbidity from transfusion may otherwise outweigh the value thereof.

We believe that we have demonstrated that preoperative restoration of the volume of blood by transfusion of whole blood according to calculations correctly made decreases surgical risk in patients severely debilitated from thyroid disease when the patient is properly prepared and when the operation is adequately performed by the off-the-trachea method, a technic recently detailed before this society; the mortality or morbidity need not then be feared in the patient with hyperthyroidism.

I would like to add that Dr. Clark should be congratulated for the meticulous study he has put into this work. It required months of application in a physiologic laboratory before he was able to standardize his own work as well as that of the technicians who have assisted him.

Although I had not intended to discuss Dr. Jackson's paper, I would like to suggest that in the evaluation of cure in his patients the hypoproteinemia exhibited in the loss of hemoglobin and the slow replacement of this hemoglobin during convalsecence probably account for the late recovery of patients treated with thiouracil as well as of those who are operated on. We have observed that with whole blood transfusion which restores the blood to optimum levels the recovery is remarkably rapid and the lag of time of several months before there is gain in weight is decreased to a few weeks.

Dr. Arthur Butler McGraw, Grosse Pointe, Mich.: The ideas expressed in Dr. Jackson's paper are such as I have been waiting patiently and hopefully to hear since the thiourea group of drugs has come into widespread use in the treatment of hyperthyroidism and in the preparation of patients for operation.

In the clinic at Henry Ford Hospital, over a comparable period considerably fewer patients have been prepared for operation with either thiouracil or propylthiouracil than are reported by either Dr. Jackson or Dr. Cole. My colleagues and I have had one annoyance in handling these patients; I wonder whether Dr. Jackson has encountered this and, if so, what he has done about it.

Fully half of our patients who have come to operation following the use of thiourea drugs have been persons who have had that treatment outside our hospital, entirely out of our control, and whose history of its use has been difficult to get. The history has been vague, or, when fairly definite, it brings out the surprisingly haphazard administration of either or both of these drugs and an as-

tounding failure, apparently, on the part of general practitioners to realize the importance of carefully made clinical and laboratory checks against impending hazards of these drugs.

I think that it will be generally agreed that it is a great help to the operating surgeon to study the patient in the preoperative period as much as possible. We have been puzzled as to what is the exact thyroid status in a number of patients and as to when to operate, whether we should continue treatment with propylthiouracil and as to how toxic the patients were in the early stages of the disease.

DR. WILLARD BARTLETT, JR., St. Louis: The work of Dr. Clark and Dr. Lindem rounds out one more step in our knowledge of the fundamental biochemical derangements of hyperthyroidism. I am particularly happy to see this work coming from one of the Veterans Administration hospitals. I am sure that these institutions will be the source of many such contributions in the future, from the staff and house officers.

I thought that it might be of interest to members of this group, most of whom do thyroidectomies and many of whom perhaps have not had any particular interest in following the development of knowledge of biochemical derangements in hyperthyroidism, to review briefly those things as they bear on this particular problem.

As far as protein is concerned, it is not sufficiently realized that, as was shown in 1934, there is an accelerated emptying time of the small intestine in patients with hyperthyroidism. Consequently, the length of time during which absorption can occur from the small intestine is diminished. That there is also increased catabolism of protein with negative nitrogen balance has been well known. During the thirties we learned that hepatic function is disturbed in hyperthyroidism, so severely in many patients that hepatic failure was thought to be the important cause of the development of crisis, although this view has been largely abandoned. However, deficient formation of albumin in the plasma by the liver is obvious and is now well recognized. That the concentration of protein in the plasma was frequently lowered in such patients was shown by Bartels in 1938, and I made the further observation that a reversal of the albumin-globulin ratio regularly occurred in the immediately postoperative period of forty-eight hours.

About fifteen years ago I became interested in some of the steps in intermediary metabolism. About all that was known was that patients with a thyrotoxic condition had increased consumption of oxygen—that is, elevation of basal metabolism and accelerated circulation. Over a period of years my own particular interest lay in studying the acid base mechanisms in hyperthyroidism, and in the late thirties I published a series of papers demonstrating that it was characteristic and, I believe, the fundamental biochemical derangement of hyperthyroidism that the patients have acidosis, which remains compensated when they are at rest but which quickly becomes decompensated with muscular exertion or in the exacerbations of their disease. Ketosis is one important source of acidosis.

Certainly, insufficient attention was paid to the contribution of Maddock and Coller, members of this association, in the middle thirties, regarding the retention of water by the tissues in the immediately postoperative reactions in patients with hyperthyroidism. The implications of the protein and acid base derangement that I have been discussing and their observation were largely overlooked, and at one time it became almost fashionable to try to get 4,000 to 6,000 cc. of fluid in every twenty-four hours into patients with hyperthyroidism if they showed any tendency to have serious reactions, largely on the basis that they had fever, though the elevation of temperature, as shown by Maddock and Coller, was characterized by retention of water. The tissues were unable properly to handle and get rid of additional water given intravenously at a time when the temperature was rising.

The disastrous consequences of such a policy and getting too much aqueous solution into the patient became clear by the experience of many physicians, and in 1940, in a paper, "The Hydration of the Hyperthyroid Patient," I again reviewed these factors and urged that fluids (other than those given orally) be limited in the postoperative phase, following a regimen that could be called dehydration, which involves the use of hypertonic solutions intravenously, not only dextrose but sorbitol. I made the point—getting back by the roundabout way to the essayist's point—that large volumes of isotonic aqueous fluid could not be given patients with postoperative reactions, particularly if it was intended to introduce the fluid directly into the circulation, without giving first an adequate amount of plasma or of whole blood in order to increase the total circulating proteins and their colloid osmotic pressure.

When that principle was violated the patients tended to experience peripheral circulatory failure or crisis, which is characterized, of course, by pulmonary and cerebral edema. It was not then known that the total circulating protein and the total volume of plasma were decreased in hyperthyroidism, but it is known today, and it is one more important step in the knowledge of what happens to these patients. All the cells of the body participate in the biochemical derangements characteristic of hyperthyroidism: (1) acidosis, particularly with ketosis, (2) arterialization of the venous blood which has passed through the capillary so rapidly that its oxygen content is not taken up adequately, (3) decrease in the concentration of proteins in the plasma, reversal of the albumin-globulin ratio in exacerbations and decrease in total circulating protein and total volume of plasma and (4) tissue anoxia and increased oxygen need.

Dr. Arnold Jackson, Madison, Wis.: I would like to add my congratulations, as a representative of the American Goiter Association, to Dr. Clark and Dr. Lindem on their paper. I hope that they can present it at the meeting of the goiter society.

It takes a long while to evaluate a new drug properly and in about another year there will be more answers to the questions relating to propylthiouracil. In the meantime, work with radioactive iodine is progressing. One of the physicians doing most of the work on the subject expressed the opinion that now he can abate hyperthyroidism with the drug, but he cannot control it. Radioactive iodine may produce decided myxedema.

To emphasize what Dr. McGraw said, physicians interested in thyroid disease will see a lot of complications resulting from treatment with these drugs this year. I have seen several patients with cutaneous reactions from the use of thiouracil. The problem is in deciding whether patients who have been receiving propylthiouracil for one month or two or three months had a toxic goiter when treatment with the drug was started. It will be a problem to decide what to do when one is called in consultation in such cases. Every physician in the country will be using propylthiouracil in the next few months. I feel that there is no longer any reason to use thiouracil, because propylthiouracil is so much safer. I think that all physicians should use that instead.

Dr. John H. Clark, Salt Lake City: I would like to offer a reminder of the importance of hemoglobin. In the past, "hypoproteinemia" has been emphasized, with neglect of the bottleneck in the metabolism of protein. If one will remember the importance of hemoglobin replacement, the patients will be benefited, regardless of the type of treatment given.

SURVEY OF RESULTS OF OPERATIONS FOR HERNIA IN ROCK COUNTY, WISCONSIN

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AND

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AND

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IN SPITE of the fact that the great mass of surgical operations in this country are performed by ordinary surgeons and general practitioners, published results of operations generally come from the large centers and educational institutions, where the work is done by a highly select group of surgeons or carefully supervised house surgeons. In Wisconsin there are approximately eight thousand, one hundred and forty-five beds in approved (American College of Surgeons approved) general hospitals, and only eight hundred and seventy-five of these are under the direct supervision of the state university medical school. One other group of hospitals, in the only metropolitan center in the state, furnishes clinical material for a medical school, but does not come under direct control or supervision. In addition, there are five thousand, one hundred and seventy-seven beds in general hospitals throughout the state in which an undetermined amount of work is done. These hospitals are not approved by the American College of Surgeons. To date there has been no accurate method of determining the number or classification of operations performed in this large group of hospitals, and it is obvious that statistics covering the work of a highly trained group of specialists in less than 10 per cent of the hospital beds in the state can hardly represent a true picture of the work of the average surgeon and general practitioner in the small hospital.

It is because of this general lack of knowledge concerning the work in the average hospital that the Rock County Medical Association, through its surgical committee, has carried on a survey of surgery on a county-wide basis. In a study of appendicitis, published in 1943 in

Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 4, 1947.

the *Wisconsin Medical Journal*,[1] 6,482 cases were analyzed. The following year surgical treatment of the biliary tract was surveyed and reported on, and this year the study of appendicits was brought up to date and a report made.

A review of the subject of hernia was undertaken in 1944 and presented in the form of a symposium before the Rock County Medical Society and a state surgical group, but it has never been published.

In this study, as in the others, there are inaccuracies and a certain lack of information in the records that detract from the value of the material. For instance, there is little distinction between direct and indirect inguinal hernia, both in the primary and recurrent types; also, in the terms describing the types of operations and in the description, there is confusion. In general, however, the term "Bassini" indicates transposition of the spermatic cord and "Ferguson-Andrews" indicates repair without change in position of the spermatic cord. In many instances it is difficult to understand just what type of operation was performed.

EVALUATION OF RESULTS

Evaluation of the results is difficult. In a follow-up questionnaire, answers were obtained from about 40 per cent of the patients, but to take the patient's word regarding recurrence is not always accurate, for it is not uncommon on routine examinations to see recurrence following an operation for hernia which the patient did not suspect. It should be the responsibility of the individual surgeon to check and record his results. In one small group in which this was done, over 80 per cent of the patients operated on over a period of years were examined by us, the patients having responded to a letter requesting information and a visit.

Results vary considerably between communities and persons. In hospitals of approximately the same size, the more physicians there are performing operations the poorer the results appear to be, and, individually, a physician who operates only occasionally appears to have a much higher percentage of failure than one who has a more comprehensive surgical practice.

This statistical report will present combined figures from two major hospitals; except when there is a significant difference they will be referred to as group I and group II. A third hospital in the county was included in the study on appendicitis, but was not surveyed for operations for hernia.

Table 1 shows a total of one thousand, one hundred and twenty operations for all types of hernia, representing the work of fifty-three

1. Snodgrass, T. J.; Munn, W. A., and Flarity, T.: Thirty-Five Year Survey of Appendicitis in Rock County, Wisconsin. M. J. **42**:928, 1943.

surgeons, twenty-three in group I and thirty in group II, covering the period from 1929 to 1943, inclusive.

Lack of accurate diagnosis of the type of hernia, either before or after operation, is evident. In the greatest number of cases of inguinal hernia, no attempt was made to differentiate between direct and indirect inguinal hernia. Cases of combined direct and indirect hernia are almost absent, and in the original figures group I reported 83 cases of direct hernia and 235 of indirect hernia, while group II reported 122 cases of direct and 57 of indirect hernia, with 232 in which no attempt to classify was made.

TABLE 1.—*Type of Hernia and Number of Cases Surveyed*

Type		No. of Cases
Inguinal		846
a. Direct	205	
b. Indirect	292	
c. Not differentiated	349	
Femoral		79
Ventral		120
Umbilical		53
Diaphragmatic		3
Unclassified (no operation)		17
Direct and indirect		1
Sliding		1
TOTAL		1,120

TABLE 2.—*Classification of Inguinal Hernias and Number of Cases*

Classification		No. of Cases
Unilateral Inguinal Hernia		846
Reducible	664	
Irreducible	58	
Strangulated	76	
Strangulated but reducible	48	
Gangrenous	0	
Bilateral Inguinal Hernia		135
Direct	56	
Indirect	60	
Not classified	19	

TABLE 3.—*Femoral, Ventral and Umbilical Types of Hernia*

Type of Hernia		No. of Cases
Femoral Hernia		79
Reducible	49	
Irreducible	1	
Strangulated	29	
Gangrenous	0	
Ventral Hernia (including epigastric)		120
Reducible	90	
Irreducible	4	
Strangulated	26	
Umbilical Hernia		53
Reducible	42	
Irreducible	0	
Strangulated	11	

In table 2 the inguinal hernias are classified, and in this group are included 135 cases of bilateral inguinal hernia. In group I, 10 per cent were classed as strangulated or irreducible, while, in group II, 20 per cent were of the complicated type and in 48 cases the hernia was reported as strangulated but reducible. The inguinal hernia in 9 per cent of the total group of 846 cases was strangulated.

Table 3, covering cases of femoral, ventral and umbilical hernia, shows that of the femoral type the hernia was strangulated in 36 per

cent of cases. In the ventral type the hernia was strangulated in 47 per cent, group II having a much higher percentage than group I; in the umbilical type, the hernia was strangulated in 20.7 per cent of cases.

Eighty per cent of the patients were male, and 20 per cent were female. While hernia, especially the inguinal type, is usually considered congenital, it takes years of stress and strain before its development necessitates operation, the largest number of hernias requiring operation occurring at age 60 or over. The average duration of the hernia before operation in this survey was five to five and one-half years. Sixty patients stated that they had worn a truss successfully before operation; 180 were unsuccessful in the use of a truss.

TABLE 4.—*Sex and Age Incidence*

Age	No. of Cases
0-10	76
10-19	68
20-29	186
30-39	179
40-49	186
50-59	187
60 and over	238

TABLE 5.—*Type of Repair and Number of Cases*

Type of Repair	No. of Cases
Bassini	475
Ferguson-Andrews	351
Mayo type	109
Anatomic repair	43
Repair from above	20
Repair from below	34
Halstead	3
Babcock	2
Zimmerman	2
Unstated	81

TABLE 6.—*Suture Material Used and Number of Cases*

Type of Material	No. of Cases
Chromic surgical gut	769
Plain surgical gut	143
Kangaroo tendon	4
Silk	23
Rustless steel wire	60
Fascia lata	31
Unstated	90

The average hospital stay was ten and one-quarter days following operation. With early ambulation, the average period of hospitalization will doubtless decrease.

The use of a proper name to designate a surgical operation is undesirable, for the name survives long after the details are forgotten and so many variations appear under the same name that it is difficult to classify the type. In general, however, in group I the Ferguson-Andrews type of operation was the popular method and was used in 319 cases and the Bassini type in 111 cases. In group II the Bassini type of operation was used in 364 cases and the Ferguson-Andrew type of operation in only 32 cases.

Chromic surgical gut was the suture of choice in a majority of cases. Wire sutures were utilized in the work of a limited group of

surgeons, as were the living fascial sutures, the latter being used in cases in which there was a large inguinal (both primary and recurrent), ventral or umbilical hernia.

Inhalation anesthesia was the most popular type, with spinal anesthesia being used rather extensively in one of the hospitals. Infections of the upper part of the respiratory tract and wound infections were the commonest complications. Nineteen per cent of all the operations were followed by some type of postoperative complication.

Table 9 records the deaths following operation and some which occurred without operation. In this series there were 28 deaths, a mortality rate of 2.5 per cent. In group I, in a series of 594 cases,

TABLE 7.—*Anesthesia*

Type of Anesthesia	No. of Cases
Ether	315
Ethylene	413
Cyclopropane	72
Combined (local and inhalation)	35
Procaine hydrochloride (local)	29
Procaine hydrochloride (spinal)	220
Not stated	36

TABLE 8.—*Postoperative Complications*

Type of Complication	No. of Cases
Respiratory	55
Wound infection	54
Vascular	32
Genitourinary	41
Gastrointestinal	30
Total	212

TABLE 9.—*Deaths*

	No. of Cases	No. of Deaths	Mortality (percentage)
Total	1,120	28	2.5
		By Group	
Group I	594	8	1.4
Group II	526	20	3.8
		Type of Hernia	
Inguinal	846	18	2.1
Femoral	79	4	5.0
Ventral	120	4	3.3
Umbilical	53	2	3.8
Unclassified			
No operation	17	(3)	
Miscellaneous	2	0	
Diaphragmatic	3		
Strangulated	178	21	12

there were 8 deaths, or 1.4 per cent; in all but 1 there was strangulation. In group II there were 20 deaths in 526 cases, 3.8 per cent mortality; in 14 cases there was strangulation.

Twenty-one deaths occurred in a total of 178 cases of strangulated hernia of all types, a mortality rate of 12 per cent. Three patients with strangulated hernia died without operation and are not included in the totals. In the cases of uncomplicated hernia, the mortality rate was 0.7 per cent. The death rate is much higher for cases in which there is femoral, ventral or umbilical hernia, but there is a high percentage of strangulation in these cases.

Table 10 shows the causes of death as listed in the records.

Of one thousand, one hundred and twenty questionnaires sent out from each of the two hospitals surveyed, there were four hundred and fifty-seven replies, or 40.8 per cent. The recurrence of hernia in 457 cases is shown in table 11.

Statistics on the rate of recurrence are based on the 457 replies to questionnaires. However, we have included in this rate the patients operated on for recurrent hernia in the hospitals in which the original operation was performed. Another factor to be considered is that during this period many of the young men were in the Army and did not answer the questionnaire. Their acceptance into the Army probably indicated cure of the hernia.

TABLE 10.—*Causes of Death*

Cause	No. of Cases Group I	Group II	Total
Myocarditis	1	7	8
Paralytic ileus	0	2	2
Pneumonia	3	2	5
Pulmonary embolism	1	1	2
Peritonitis	0	2	2
Unstated	3	6	9

TABLE 11.—*Recurrence of Hernia*

No. of Patients Examined		Recurrence (No. of Patients)	Percentage
	457	79	17
By Group			
Group I	213	26	12
Group II	244	53	22

TABLE 12.—*Time of Recurrence*

Within 1 yr.	32	41
Within 3 yr.	10	12
Within 10 yr.	10	12
Within 20 yr.	5	6
Unknown	22	

The over-all rate of recurrence was 17 per cent: 12 per cent in group I and 22 per cent in group II. In 41 per cent of the cases there was recurrence within one year of the operation. There was recurrence in 15 cases in which operations for bilateral inguinal hernia had been done and in which operation was done on both sides at the same time. Of the entire group, there were 135 cases of bilateral inguinal hernia in which operation had been done, which constituted 12 per cent of the total number of cases and accounted for 19 per cent of recurrence.

In group I, in which the Ferguson-Andrews type of operation was used, the rate of recurrence was 12 per cent, while in group II, in which the Bassini type was utilized, the rate was 22 per cent. Several factors may enter into this difference, namely, in group II a larger group of men performed the operations than in group I and they reported a large proportion of cases of complicated hernia. It was noted that the condition in patients who have hernial repair on one

side and who return several years later for repair on the other side is likely to be classed as recurrence. Another error which has been noted is that patients who have recurrent hernia but who enter the hospital for other conditions are likely to be classed as patients who have had reoperation.

Table 13 is a resume of the answers to specific questions regarding results of operations for hernia and indicates that bulging, pain and swelling of the testicle are rather common sequelae.

Only 41 patients answered "no" to the question, "Do you consider your operation successful?" and 3 stated that they had had other operations for repair. Recurrence in the other 38 patients was found in the records.

TABLE 13.— *Résumé of Questions as to Symptoms and Answers*

BULGING:		**PAIN**	
Yes	63	Yes	91
No	359	No	337
Indefinite	11	Indefinite	14
Failed to answer	24	Failed to answer	15
SWOLLEN TESTICLE		**OTHER OPERATIONS FOR REPAIR**	
Yes	55	Yes	3
No	271	No	433
Indefinite	20	Indefinite	8
Failed to answer	111	Failed to answer	13

OPERATION FOR HERNIA CONSIDERED SUCCESSFUL

Yes	387
No	41
Indefinite	16
Failed to answer	13

TABLE 14.—*Occupation Before and After Operation*

	Total Group Before Operation	After Operation Based on Replies
Machinist	31	11
Farmer	93	43
Mechanic	99	35
Housewife	199	77
Laborer	381	170
Clerical worker	73	26
Professional worker	23	5
Student	62	16
Infant	32	4
Unstated	127	70
	1,120	457

The occupation before operation was taken from the hospital record; the occupation after operation was taken from the letter.

Table 14 shows the results of an attempt to determine whether or not the patients were able to return to the same occupation after operation.

Some additional information was gained by the study of recurrence in patients of group I, which was not available in the records of patients of group II. In group I there were eleven replies indicating recurrence. Four of them were in patients between the ages of 31 and 40; the others were distributed equally throughout the other periods of life. The Ferguson-Andrews type of operation was used in 8 and the Bassini operation in 3. Chromic surgical gut was used in 10 cases and wire in 1. The 9 cases recurrence occurred within seven months of operation. There was 1 case in which a femoral hernia de-

veloped after a successful operation for bilateral inguinal hernia. Factors influencing recurrence were infection in 5 cases, cough and postoperative complications in 3 and technical difficulty in 3; there was no adequate explanation in 4. In 1 case of bilateral hernia there was recurrence on one side, and in 1 case in which there was strangulated femoral hernia a direct inguinal hernia recurred on one side. In 1 case a direct hernia recurred after the repair of an indirect hernia.

In 14 cases of recurrent hernia in group I operation was done; in 6 of these repair was successful, and in 8 the result was unreported. In 9 of the cases the hernia was indirect inguinal; in 1 it was direct inguinal; in 2 it was ventral; in 1 it was umbilical, and in 1 it was strangulated. Twelve of the patients were male; 2 were female. The time elapsing between the first and subsequent operations was one to five years in 8 cases, six to ten years in 4 cases and eleven to fourteen years in 2 cases. In 2 cases the original operation was done elsewhere; in 2 cases it was done by another surgeon in the same hospital, and in 10 cases the second or the subsequent repair was done by the same surgeon. Original suture material appeared to be chromic surgical gut in all cases.

In the patients requiring later repair the type of recurrence was unilateral inguinal in 8, umbilical in 1, bilateral inguinal in 3, ventral in 1 and strangulated in 1. One surgeon reported a previous pantaloon type of hernia not discovered at the time of original operation.

The type of operation used in cases of recurrent hernia was Bassini in 1, Ferguson-Andrews in 7, Mayo in 2 and fascial repair in 1. The type of operation was not stated in 3 cases.

In 1 case the testicle was removed in order to repair recurrent hernia. In the repair of recurrent hernia, silk was used in 2 cases, surgical gut and silk in 1 case, surgical gut and fascia in 1 and surgical gut alone in 6 cases. In 3 cases it was not stated.

There were no complications following operation for recurrent hernia in 5 cases; a drain was placed in the wound in 1 case; infection occurred in 2 cases, and whether complications existed was not stated in 3 cases.

Twenty-nine operations were recorded in the 14 cases. In 1 case only one operation was recorded; in 8 cases two operations were reported; in 2 cases three operations were reported, and in 1 case a repair was done at the time of a subsequent appendectomy. A surgeon stated that the patient in this last case had been operated on unsuccessfully for inguinal hernia three times and was operated on successfully from the inside at the time of an appendectomy by bringing the sac up and tying it inside out.

COMMENT

A study such as this has little value as a scientific investigation, but from a practical standpoint it probably represents results similar to

those obtained in a large proportion of the hospitals in this country. From this investigation certain conclusions can be reached. First, there is a definite rate of mortality from operation for hernia, although these operations are considered simple and safe, which is much higher in the cases of complicated hernia but is significant in the cases of simple uncomplicated hernia. Second, the rate of recurrence in the cases handled by the average operator is high. Factors favoring recurrence were operation on both sides at the same time, infection, postoperative complications, technical difficulties and probably the type of operation and suture material generally used.

Analysis of results and follow-up systems in the small hospitals are just as important as they are in the larger institutions. This type of investigation should be undertaken on a state level.

SUMMARY AND CONCLUSIONS

This report is based on one thousand, one hundred and twenty operations for various types of hernia performed in two general hospitals in a county with a population of over 85,000 persons. The rate of recurrence of 17 per cent is based on four hundred and fifty-seven replies to letters to patients operated on and on information obtained from the records. There was an immediate rate of mortality of 2.5 per cent in all cases, and in the cases of strangulated hernia the rate was 12.3 per cent. The operations used in cases of inguinal hernia were equally divided between the Bassini and the Ferguson-Andrews types. In the group in which the Ferguson-Andrews type was used there was a lower rate of recurrence than in the group in which the Bassini type was used, but other factors, such as the number of men operating in the hospital and the type of hernia, must be considered.

In analyzing cases of recurrence, it is evident that in the majority of cases there was recurrence within the first year following operation, often within a few months. In the bulk of operations performed, chromic surgical gut was the only suture used. However, in a limited group of cases, wire and fascia were used, with recurrence in only 1 case.

Confusion in the diagnosis of the type of hernia and the type of operative procedure should be eliminated by proper descriptions and records. Not until hospitals have competent librarians to keep records and sufficient organization of the staff to permit complete cooperation from all the physicians who perform operations in the hospital can this be accomplished. In the modern hospital, whether large or small, surgical statistical data should be available at all times for study and inspection, for it is only in this way that one can know whether patients are receiving the measure of skill and judgment in the management of their cases that they have a right to expect.

HEPATICODUODENOSTOMY FOR STRICTURE OF THE COMMON HEPATIC DUCT

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SEATTLE

THE MAJORITY of strictures of the bile ducts are of traumatic origin, that is, injuries that occur during operation on the biliary tract. There are a number that occur as a result of inflammatory conditions, or they may be caused by the presence of a stone in the common duct. A benign or malignant tumor also may cause stricture or even complete obstruction. If the segment of the duct involved in a stricture or tumor is small, excision of the segment with end to end anastomosis will usually give good results.

When there is involvement of a fairly long segment of the duct, other operative measures must be used. I refer especially to cases in which the stricture extends upward, so that it involves a good deal of the common hepatic duct. In this type of case, anastomosis of the duct to the duodenum or jejunum has to be performed.

Herman Pearce stated that statistics show that only 23 per cent of the cases of anastomosis of the common duct to the duodenum have successful end results. This probably refers to cases in which a good deal of the common duct has been destroyed by stricture. He also stated that anastomosis of the duct to the duodenum by using a "vitallium" (contains cobalt, chromium and molybdenum) tube gave 58 per cent satisfactory results. Thirty-eight per cent of the tubes were passed into the intestine. These statistics are based on 229 cases in which "vitallium" tubes were used.

I have never been greatly impressed with the use of "vitallium" tubes, as a rigid tube of that type is a source of irritation to the tissues involved.

In 1945 Allen[1] of Boston reported on an operation which he had devised. It is generally accepted as the most satisfactory method of anastomosing a short common hepatic duct to the end of the jejunum. The jejunum is bisected at a suitable location. Intestinal continuity is reestablished by anastomosis of the proximal end of the jejunum to

Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 5, 1947.

1. Allen, A. W.: Method of Re-Establishing Continuity Between Bile Ducts and Gastro-Intestinal Tract, Ann. Surg. **121**:412-424 (April) 1945.

the side of the distal portion, leaving an arm of jejunum long enough to reach the duct without tension. Allen reported on 8 cases in which he did this operation with good results.

Other surgeons who have used this technic are enthusiastic about it. The operation has not been used long enough, however, to determine results in a large series of cases. It seems to be the best method for extensive stricture of the bile ducts thus far developed. The operation is a modification of the Whipple Roux Y operation used in pancreatectomy. It will require careful observation and follow-up of more cases properly to evaluate the operation. There was a time, not long ago, when many surgeons hailed the "vitallium" tube as the answer to this difficult problem.

In the case herein reported I performed an operation more than two years prior to the date of writing. The patient had an extensive stricture, involving the common duct and a good deal of the common hepatic duct. The technic used was different from any that I have seen reported in the literature, and it worked so well that it seems worth reporting in detail.

REPORT OF A CASE

A woman, aged 45, the mother of two children, gave a history of attacks of gallbladder disease off and on for six years. The attacks became so frequent and severe that her health was greatly impaired; she consulted a physician, who advised operation. She was operated on elsewhere in April 1944.

A cholecystectomy with drainage was done. Bile drained for two months, and during this time the patient passed five stones from the wound. Following healing of the wound, she continued to have frequent attacks of chills and fever, with her temperature reaching as high as 102 F. I first saw her Feb. 26, 1945, about ten months after she had been operated on. It was evident that she had partial obstruction of the common duct; surgical intervention was advised.

Operation was performed March 15. The ducts were finally isolated, after considerable difficulty due to massive adhesions. The dilated hepatic duct was opened, and, by means of a common duct scoop, four stones were removed from where they were lodged in the left hepatic duct, about 4 inches (about 10 cm.) above the point where the duct entered the liver. A small catheter was placed in the common hepatic duct and sutured there. The opening in the duct was then closed snugly about the catheter. In about two weeks the catheter was removed; bile continued to drain for about two months.

Approximately five months later, bile again began to drain and the patient had chills and fever. She showed no improvement, and it was decided that she had obstruction of the biliary duct and required further surgical treatment. Operation was performed October 8; four soft stones were removed from the dilated hepatic duct. It was impossible to get a probe into the duodenum through the common duct. The duodenum was opened longitudinally, and an effort was made to pass a probe into the common duct from the duodenal side, without success. The incision in the duodenum, which was about 2½ inches (about 6.5 cm.) long, was closed transversely.

I noted that after the duodenum was closed transversely, the apex of the widened bowel on the right side closely approximated the hepatic duct. It was decided to anastomose the hepatic duct to the widened bowel at this point. The

anastomosis was done over a no. 18 catheter, about 6 inches (about 15 cm.) of the catheter being inserted into the dilated left hepatic duct and about the same

Fig. 1.—Roentgenogram of the tube in the hepatic duct, taken eleven days after operation.

Fig. 2.—Roentgenogram of the tube in the hepatic duct, taken ten weeks after operation.

length into the duodenum. The completed anastomosis was about 1/8 inch (about 0.32 cm.) distal to the junction of the right and left hepatic ducts. The catheter

fitted rather snugly at the site of the completed anastomosis. It seems important that it should, so that it will not pass too soon, at least not until epithelization of the duct at the site of anastomosis has occurred.

Bile drained after the operation for two weeks, and the patient left the hospital on the seventeenth day. There had been no bile in the stool two days before operation. The icterus index on the day of operation was 40 plus. This gradually diminished, so that it was only 14 plus when she left the hospital. The tube was passed after seven months, accompanied with rather severe pain in the right upper abdominal quadrant. She has remained well to the time of writing, twenty-six months after the operation.

Fig. 3.—*A*, longitudinal incision in the duodenum. *B*, the duodenum is sutured transversely.

COMMENT

I believe that this operation is applicable in many cases in which more radical surgical treatment is now being done. After exploration of the bile ducts, if it is decided to apply this technic, mobilization of the descending duodenum should be done first. A longitudinal incision, at least 3 inches (about 7.6 cm.) long, is then made in the duodenum (fig. 3*A*).

Care should be taken not to injure the pyloric sphincter muscle in making this incision. The duodenum is then sutured transversely (fig. 3*B*). The triangular projection of the widened duodenum pointing toward the liver will closely approximate the common hepatic duct. This facilitates anastomosis of the duct to the duodenum. Anastomosis should be performed over a rubber tube. The duodenum should be sutured to the ligamentum hepatoduodenale by at least one suture on each side of the anastomosis to give added security.

This operation eliminates the likelihood of tension at the site of anastomosis, as the duodenum is so enlarged transversely that it brings the apex of the triangle, formed by the transverse suturing of the duodenum, close to the hepatic duct. There is practically no likelihood that food might be forced against the duodenum at the site of the duct, as peristalsis forces the food into the second part of the duodenum, directly through the enlarged lumen of the duodenum and

well away from the site of anastomosis. This would, therefore, tend to eliminate the danger that food might be forced into the duct and cause cholangitis.

The report of 1 case in which the operation was successful does not mean much. Many such operations will be required to prove its worth. Mechanically, it seems to offer hope in suitable cases, such as the one reported, and in cases of anastomosis of the common duct to the duodenum, in order to relieve or prevent tension at the site of anastomosis.

Among other functions, the biliary and pancreatic secretions work together in the digestion of fats and alkalization of the intestinal contents to aid digestion. It seems essential, therefore, that whenever possible the duct should be connected to the duodenum as near its original site as possible, so that the bile can function in its normal physiologicoanatomic environment.

705 Broadway.

DISCUSSION

De Paul H. T. Thorlakson, Winnipeg, Manitoba, Canada: Dr. Lamson has presented us with another solution to a problem which represents one of the formidable and rather regrettable challenges to abdominal surgeon's, namely, the relief of obstruction to the common bile duct resulting from previous operative injury.

To emphasize the gravity of the situation, one might recall the statement made by an eminent British surgeon, who said that of the patients who sustain injury to the bile duct one third die soon after the operation, another third die from the operative measure undertaken later to repair the defect and, of the remaining third, who recover from the secondary operation with good results, many suffer from recurrent attacks of pain, jaundice and fever, until death ends their suffering.

By earlier surgical intervention, by more adequate and scientific preoperative preparation and by modifying the operation to meet the varying needs of the situation, I am sure that many surgeons could report improvement in the results in the late repair of injury of the bile duct.

Whether the surgeon elects to perform an end to end anastomosis of the bile duct, a choledochoduodenostomy, a choledochojejunostomy or, as occasion may necessitate, a hepaticoduodenostomy, the surgical principle to emphasize is free anastomosis over the tube without tension. In other words, the resulting lumen must be adequate and free, because ascending cholangitis occurs only when there is partial obstruction at the site of the anastomosis.

As has been emphasized by Dr. Lamson, tension of the site of union, because of failure to mobilize the structures to be sutured together, is one of the common causes of recurrent stricture. Unless polythene (polyethylene) tubing, the possible uses of which were so admirably presented by Dr. Grindlay and Dr. Mann, becomes available, it is perhaps of little moment what type of tubing is used, provided that it does not fit too tightly and does not easily become occluded and provided that it can be removed or passed relatively easily when healing is complete.

Indefinite retention of the tube is not desirable. The tube should be used as a temporary splint during the period of healing, when edema may occlude the lumen.

Surgeons who, on occasion, are confronted with the task of reconstruction of the biliary duct are keenly interested in any and every method which may assist in overcoming the technical difficulties involved in the operation.

The procedure presented by Dr. Lamson is another maneuver which will increase versatility in dealing effectively with one of the major hazards of abdominal surgical treatment.

DR. J. M. WAUGH, Rochester, Minn.: As has been so well pointed out, in the main, one can say that there are three methods of attack in reconstruction of the strictured common bile duct. The first is hepaticoduodenostomy. Dr. Walters has been interested in this problem of stricture for well over twenty years and has had more experience with it than have his associates at the Mayo clinic. He still favors, in most instances, either hepaticoduodenostomy or choledochoduodenostomy. He usually uses the Mayo-Robson type of polythene tube. Second, there is choledochojejunostomy, which Dr. Allen and Dr. Cole favor. Third, of course, is the end to end anastomosis which Dr. Cattell and Dr. Lahey favor, and which, I think, most surgeons use when it is possible.

A few years ago, when I was confronted with a few cases of this type, when Dr. Walters was in the Navy, it seemed to me that if union could be effected without any tube between the common duct or hepatic duct and the duodenum it would be preferable, since excellent results have been reported by Dr. Ladd of Boston in the congenital type of stricture. Many children for whom such union had been effected have had no difficulty for years. However, I noted that without some splint most of these patients returned for treatment in a short time, but there are a few who have remained well. I am frank to admit that the latter are exceptional. I started to use a "vitallium" (contains cobalt, chromium and molybdenum) tube as a splint in choledochoduodenostomy. In 75 per cent of cases either the tube passed too soon and the stricture recurred or the tube became plugged. I am sure that in not over a fourth of the cases are the tubes still in place and functioning well.

Since my experience was not good with the "vitallium" tube and choledochoduodenostomy, I employed end to end anastomosis of the common duct. I have observed in the last three years, as I know has been Dr. Claggett's experience, that in most instances if one persists in the dissection one will find the lower end of the common duct, and I feel that the ultimate function is better if one does an end to end anastomosis.

Following the poor results with "vitallium" tubes, I did the anastomosis over a rubber T tube, and within the last month I have had 2 patients return for treatment after apparently a satisfactory end to end anastomosis over the tube; the T tube had become plugged and had to be removed, and within a month or six weeks after removal the stricture had reformed.

In these 2 patients, because the polythene tube was not available, I used "vitallium" tubes.

The point of recurrence of the stricture is usually not on the intestinal side. I have never seen it on the intestinal side. It is always up in the ductal system, and sometimes the liver is so large that it completely overgrows the ducts that ordinarily are extrahepatic, and that is one of the real difficulties as far as technic is concerned, to get a normal portion of the duct with direct union to either the duodenum or the jejunum.

I have not done Dr. Allen's and Dr. Cole's operation. I believe that that operation has been used two or three times at the Mayo clinic, but if I cannot find the end of the duct I favor a choledochoduodenostomy.

I think that in the future, if polythene tubes are available, I would favor them. I believe that Dr. Lamson's contribution is a real one, for, if one is going to use hepaticoduodenostomy or choledochoduodenostomy, his technic will help

prevent retraction of the duodenum and it will also help prevent obstruction. I know of at least 1 case in which it was necessary, because of duodenal obstruction after the anastomosis was effected, to do a gastroenterostomy. I believe that the technic of closing the incision in the duodenum in the opposite axis, so that it can be sutured to the upper stump of bile duct without tension and without causing obstruction, is a real contribution.

Dr. Warren H. Cole, Chicago: So many cases in which there is stricture seem to come to the attention of my associates and me that I would like to make a few comments regarding our experience. In the past ten years we have had 46 patients with strictures; these were of various types. We utilized about ten different types of operations, largely because the types of stricture were so numerous.

We have had poor results with anastomosis of the duodenum to the stump of the hepatic duct, unless the stump is at least ½ inch (about 1.3 cm.) long. Unfortunately, we see few duct stumps longer than ½ inch. Maybe we are unlucky, but they are not common in our experience. However, Dr. Lamson presents his modification, which amounts to enlargement of the duodenum at the anastomosis. I think that this might minimize the recurrence of stricture at that point.

We have had good results with the "vitallium" tube. Many of you saw Dr. Pierce's recent article, which Dr. Lamson referred to, in which Dr. Pierce reviewed the experience of surgeons throughout the country. It was amazing how high a percentage of good results he reported with "vitallium" tubes. I am sure that these tubes will become plugged in a large percentage of cases, particularly if they are left in place a year or more. There would be better results if the tubes remained in the patient for less than six months. It is difficult, of course, to anchor a tube with just enough silk sutures to allow the tube to pass in four to six months. However, we have been able to accomplish this in about three fourths of the cases by anchoring the tube to the liver with no more than two silk sutures. We have only 2 cases in which the "vitallium" tubes have remained in place longer than one year. In all the others the tubes have passed, but results have been good in 70 to 75 per cent of the cases in which the tube remained four to six months.

At the present time we are not using "vitallium" tubes, not because we were entirely dissatisfied with them but because we are aware of their shortcomings. We are using several modifications and using one modification for a reason which was emphasized by Dr. Waugh, namely, that the stricture does not occur on the intestinal side. It occurs on the side of the liver. To obviate the difficulty of having recurrence at that point, we now remove the serosa and muscularis from the submucosa and mucosa at the end of the Roux Y arm of the jejunum and insert this as a graft over a rubber tube up into the opening in the liver, hoping that the mucosa will act as a graft and bridge this area where the stricture is so likely to form.

I would also like to emphasize that one cannot repair these strictures with just one type of operation. Several different types of operations must be utilized. I do not know of any other condition for which so many different technics are necessary to repair all the different types of strictures.

I want to emphasize another point that Dr. Waugh made, which is important: One must search long and carefully for the distal end of the duct, because the sphincter of Oddi is an important structure which cannot be duplicated. Moreover, repair of the stricture is comparatively simple when both ends of the duct have been found.

Dr. Joseph Smith, Wausau, Wis.: I wish to report on a case in which my associates and I had a unique experience.

The patient was an obese woman, who weighed 220 pounds (99.8 Kg.) and was 39 years of age. She had had frequent attacks of what was diagnosed as cholecystitis. In July 1943, a cholecystectomy was done and no stones were seen, but a thickened noncalculous gallbladder was removed. There were a good many adhesions around the area of the gallbladder, and, apparently, in tying off the bleeding points, the common hepatic duct must have been included in the ligature.

About three or four days after the operation the patient began to have fever and pain, and a day or two later bile began to pass through the drainage tube. This continued at intervals, a biliary fistula having developed. During the time that the fistula was open, she was comfortable. When the fistula closed, she had recurring attacks of fever and jaundice.

In December we did an exploratory operation, to ascertain whether the damage to the duct could be repaired. We observed that the common hepatic duct was included in a mass of adhesions, which made it impossible to do any repair work on the duct itself, but we were able to locate the common duct. At a point about 2 inches (about 5 cm.) from the duodenum we made a small incision in the common duct, and, by passing a small flexible bougie up into the duct, we were able to get through the stricture in the hepatic duct. This was dilated until we were able to pass a no. 18 French urethral catheter.

In view of the bad results that have followed permanent intubation of the duct, we decided to insert a Nélaton catheter and bring it out through the wound, with external intubation of the hepatic duct. The tube was carried up to about the junction of the right and left hepatic ducts, brought out through the wound and left in place.

Bile drained through the tube for a time, and then the bile seemed to pass along the tube and down into the common duct, without going through the tube.

Several times, while the tube was in place, it became occluded, and the patient had some pain and jaundice. We removed the tube after it had been in place about six weeks, cleaned out the epithelial debris and replaced it. This was repeated several times during the period that the tube was in place.

The tube remained in place for about a year and a half, and at the end of that time, the patient being free from jaundice and other uncomfortable symptoms, the tube was permanently removed and the biliary fistula closed promptly.

It is now two years since the intubation procedure was carried out, and the patient is still free from pain and jaundice. What the final result will be, of course, we do not know, but it was an easy and a comfortable way out of a difficult situation.

DR. O. F. LAMSON, Seattle: I want to thank the discussers for their discussions on this problem of biliary surgical treatment. It is another instance of the fact that so often, when a paper is presented, the real pith of the subject under discussion is brought out by the discussers.

I want to thank Dr. Thorlakson for his contribution. I recently heard him present a paper in Victoria, British Columbia, on surgical treatment for the biliary duct. He described an operation for a complication with which he was confronted when operating on a patient with severe jaundice.

Great difficulty was encountered in locating the hepatic duct. He used an aspirating needle and finally located a pocket of white bile in the liver. The bile was aspirated and the duct observed to be flush with the surface of the liver. He made an opening in the mesocolon and brought a loop of jejunum through it, sufficiently long to reach the duct without tension. Then he made a small opening in the bowel and anastomosed it to the liver around the opening of the duct. An interanastomosis was done between the two segments of jejunum below the mesocolon, and the bowel was sutured to the mesocolon. The patient made a satisfactory recovery and has remained well since the operation about a year ago.

SURGICAL SIGNIFICANCE OF HEMATEMESIS AND MELENA

HAROLD LINCOLN THOMPSON, M.D., Ph.D.
LOS ANGELES

ONE OF the most distressing, if not the most common, symptoms of gastrointestinal disease is bleeding. Hemorrhage is manifest in two ways: by hematemesis, the vomiting or regurgitation of gross blood, or by melena, which is defined as the discharge from the bowel of black altered blood. The custom of discussing these two conditions together is based on their common genesis and their frequent symptomatic coexistence. In this discussion the broad use of the term melena will be used to include the discharge of black, red or occult blood from the anus.

At the outset, it should be recalled that hematemesis and melena are signs and not disease entities. Moreover, their pathogenesis may lie within or without the digestive tract. These symptoms are of special interest to the surgeon for two reasons: First, as pointed out by Jones, the implication in a given case or consideration is that the problem may be medical or surgical. Second, and corollary of the first, the recent success of esophageal surgical treatment now makes the entire gastrointestinal tract subject to surgical attack. Thus, in accordance with Jones's dictum, few conditions test to a greater degree the combined knowledge, judgment and courage of the physician and the surgeon. The patient with hematemesis and melena, therefore, from the outset should be under the joint observation of an experienced internist and a competent surgeon.

PATHOGENESIS

Since it is not within the scope of this paper, reference is made elsewhere for a complete list of those causes of bleeding from the gastrointestinal tract which are of surgical significance.[1] It is sufficient here to say that a wide variety of factors contribute to or cause blood

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1. Thompson, H. L.: Hematemesis and Melena, in Piersol, G. M., and Bortz, E. L.: The Cyclopedia of Medicine, Surgery and the Specialties, Philadelphia, F. A. Davis Company, to be published.

to be expelled from the gastrointestinal tract. An abbreviated list is included here:

Diseases of the respiratory tract, ranging from:
  Epistaxis, pulmonary embolism and malignant growth to basal skull fracture.
Diseases of the gastrointestinal tract:
  (*a*) Mouth, pharynx and esophagus
  (*b*) Stomach and doudenum
  (*c*) Jejunum and ileum
  (*d*) Colon, rectum and anus
Diseases of the hepatic and biliary tract.
Diseases of the pancreas and spleen.
Diseases of the blood vessels and blood-forming organs.
Hereditary diseases:
  Telangiectases
Deficiency states:
  Vitamins C and P deficiencies
Acute intoxication, including:
  Uremia
Intoxication caused by sulfonamide drugs.
Intoxication caused by burns to the body surface (Curling's ulcer)
Trauma:
  Foreign body
  Instrumentation

SYMPTOMS AND SIGNS

Whereas slight or gradual hemorrhage from the digestive tract may produce few, if any, clinical signs beyond pallor and weakness, severe hemorrhage is indicated by cyanosis, tachycardia, hypotension, impending shock or shock.

Shock.—The essential feature of shock is systolic blood pressure at or below 80 mm. of mercury. In the shock of hemorrhage the characteristic manifestations are thirst, air hunger, restlessness and anxiety, increasing to respiratory difficulty and failure before the heart ceases beating. Prompt recognition of shock is imperative, because its presence demands early and active treatment.

Changes in the Blood.—Blood constitutes about 9 per cent of body weight, of which blood plasma comprises about 5 per cent and blood cells about 4 per cent. Early after hemorrhage the volume of blood is restored by withdrawal of fluids from body tissues. Aside from initial limited increase in cell volume from contraction of the spleen, blood cells, on the contrary, are restored slowly by regeneration by the blood-forming organs. During hemorrhage, the clotting time increases rapidly and the platelet count rises. Leukocytosis is not uncommon. When more than 40 per cent of the total volume of the blood is lost, these compensating factors no longer are adequate and infusions of blood or plasma are required to prevent death.

LABORATORY OBSERVATIONS

Quantitative Blood Estimations.—In hemorrhage the erythrocyte count, hemoglobin estimation and hematocrit reading are designed to show the ratio of cell volume to plasma volume. If these values are to be employed profitably, the underlying physiologic aspects must be understood. It is self evident that, in hemorrhage, loss of blood takes place at the expense of both plasma and corpuscles. Because of an appreciable delay in the alteration of the circulating blood after hemorrhage, these readings are subject to considerable variation, with the result that they are relative and not absolute determinations. Thus, in early hemorrhage there is little, if any, change in these three clinical laboratory estimations. In a matter of hours, however, depending on the availability of tissue fluids, electrolytes and proteins, restoration of plasma is accomplished, so that during the period of early clinical recovery both hemoglobin and cells fall in proportion to plasma, because of the dilution of blood by the addition of body fluid. Not until twelve to forty-eight hours after the cessation of hemorrhage, therefore, may the full extent of bleeding be known by these methods. On transfusion of whole blood there is a relatively and clinically greater increase in plasma volume than in cell volume. Early adjustment in plasma volume takes place by the passage of transfused blood into the tissues. Permanent recovery from hemorrhage is possible only after weeks, in which the play of the regenerative processes results in an increase in erythrocytes and hemoglobin volume. The latter is a matter of common experience.

The therapeutic implications of these facts are:

1. Since the volume of blood is an element essential to the maintenance of normal blood pressure, in hemorrhage the restoration of total volume of blood, preferably by the transfusion of whole blood, is of immediate importance.

2. Since the fraction of blood required for ultimate recovery, on the contrary, is the blood cell, it may be preferable, at least in theory, to infuse washed blood corpuscles.

Azotemia.—The observation of Sanguinetti on the elevation of urea in the blood in patients with bleeding peptic ulcer has been confirmed amply by others. The azotemia may appear as early as two hours after the onset of bleeding of the upper part of the gastrointestinal tract. In moderate hemorrhage the elevation of urea in the blood is correspondingly moderate, that is, 70 mg. or less per hundred cubic centimeters. In severe or massive grades of hemorrhage, higher values, as 100 mg. or more per hundred cubic centimeters, are observed. Recurrences of bleeding are followed by secondary increases

in urea in the blood. Thus, the elevation of the level of urea in the blood corresponds rather accurately to the degree of blood lost. If bleeding ceases after the initial hemorrhage, the urea reaches a maximum the day following, falls to high normal levels in the next two or three days and to normal levels in seven to ten days. If the curve falls to such normal levels, therefore, the cessation of bleeding, without impairment of renal function from shock, may be assumed. The azotemia, therefore, may be regarded as an index to the amount of protein absorbed from the bowel. Schiff and Stevens[2] observed that in groups of cases in which the concentration of urea nitrogen remained below 70 mg. the number of deaths was insignificant, whereas in those cases in which the level was above 100 mg. per hundred cubic centimeters the mortality was 80 per cent. Observations on urea in the blood in the early period following hemorrhage are, therefore, of practical importance.

In a small group of cases of severe hematemesis and melena, hyperazotemia is based on dehydration, shock with resulting renal impairment and protein catalysis from starvation.

DIAGNOSIS

Reduced to simplest terms, the direct diagnosis of hematemesis and melena is based on the recognition of blood in material from the gastrointestinal tract, which is vomited, regurgitated or passed from the bowel. From a clinical standpoint, however, diagnosis is more complicated than this. It includes the determination of the possible site of hemorrhage, the pathologic condition which is present and an estimation of the general condition of the patient as a basis for appropriate treatment. The differential diagnosis of the site of hemorrhage and the pathologic condition involved is based on a knowledge of the pathogenesis of gastrointestinal hemorrhage. The estimation of the general condition of the patient and the determination of appropriate treatment are matters of clinical experience. Valuable aids to the latter consideration are frequent observation of the patient after bleeding, reevaluation of the several clinical features, as the clinical course demands, and close collaboration of the internist and the surgeon. In cases in which there is benign bleeding, diagnostic procedures may be carried out in the normal way after due consideration of the history and the physical observations. While these may be of aid in diagnosis, too often clinical features of diagnostic value are notably absent. On the contrary, obvious sources of

2. Schiff, L., and Stevens, R. J.: Elevation of the Urea Nitrogen Content of the Blood Following Hematemesis and Melena, Arch. Int. Med. **64**:1239 (Dec.) 1939.

bleeding are not always reliable. For example, bleeding from hemorrhoids or anal fissure may coexist with carcinoma of the bowel.

Laboratory aids include repeated determinations of erythrocyte, hemoglobin, hematocrit and urea nitrogen of the blood. Roentgenologic studies are of value in certain cases in which there is massive bleeding and may be utilized with safety within twenty-four to forty-eight hours after the onset of hemorrhages, particularly if the precaution of Hampton[3] and of Schatzki[4] are observed. If peptic ulcer is suspected as a site of massive or continued bleeding, any consideration of surgical treatment must take place within the first forty-eight hours in which fluoroscopy without manipulation may be undertaken. Endoscopy should be postponed until active bleeding ceases. All stools and vomitus should be saved for laboratory inspection.

In two or three weeks after the cessation of bleeding, fluoroscopy may be done with the aid of manipulation. If obstruction of the bowel does not exist, barium sulfate may be administered by mouth. Histamine achlorhydria, as determined by gastric analysis, in the presence of a demonstrated gastric lesion implies a malignant condition. Gastroscopy and esophagoscopy should be preceded by fluoroscopic studies, in order to eliminate the possibility of esophageal stenosis. Esophagoscopy is useful in obtaining biopsy material and for the identification of esophageal varices. Sigmoidoscopy should be preceded by studies employing enemas with barium sulfate. In the presence of hemorrhoids, sigmoidoscopy is mandatory in order to rule out carcinoma and other more serious sources of bleeding at the rectal or lower sigmoid levels.

Differential Diagnosis.—It is generally agreed that the most common cause of hemorrhage from the upper part of the gastrointestinal tract is peptic ulcer. If the patient has a typical history of ulcer or of some other condition in which gastrointestinal bleeding is relatively frequent, the differential diagnosis of hematemesis may not be difficult. On the other hand, early diagnosis may be extremely difficult and may involve a systematic consideration of nearly all the pathologic conditions outlined under the heading of pathogenesis, to which reference is made elsewhere.[1]

Diseases of the Liver and Spleen, or "Blood Dyscrasias."—In diseases of the liver and the spleen, or "blood dyscrasias," determinations

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3. Hampton, A. O.: A Safe Method for the Roentgen Demonstration of Bleeding Duodenal Ulcer, Am. J. Roentgenol. **38**:505, 1937.

4. Schatzki, R.: Roentgenologic Examination in Patients with Bleeding from the Gastro-Intestinal Tract, New England J. Med. **235**:783, 1946.

of blood platelet count, prothrombin time, serum protein, hepatic function with sulfobromophthalein sodium and serum albumin are required.

Obscure and Undetermined Gastrointestinal Bleeding.—Nearly every series includes a sizable proportion of cases in which, after exhaustive study, the cause of hematemesis and melena remains obscure or undetermined. There were 25 cases in the report by Berkman[5] and 9 per cent in the group reported by Jankelson.[6] In view of the complexity of the pathogenesis and the fact that most patients recover, this situation is inevitable.

PROGNOSIS

Prognosis and mortality in patients with hematemesis and melena necessarily vary with the underlying pathologic condition and with the promptness and skill with which treatment is applied. According to Wheritt,[7] the mortality figures in peptic ulcer range from 1.3 to 24.1 per cent. Recent developments which hold promise in determining mortality in cases in which there is hemorrage in the upper part of the gastrointestinal tract are determinations of volume and urea nitrogen of the blood. Bennett and his associates[8] have shown that when cell volume was less than 20 per cent, mortality did not occur, but in cases in which cell loss exceeded 50 per cent, the rate of mortality was 18 per cent. Schiff and Stevens[2] showed that when urea nitrogen of the blood was over 100 mg. the rate of mortality was 80 per cent. With reference to recurrent hemorrhage in peptic ulcer, Cullinan and Price[9] observed that the rate of mortality from single hemorrhage was 4 per cent, with a single recurrence 40 per cent and with multiple recurrences 60 per cent.

TREATMENT

The emergent nature of hematemesis may require the immediate institution of therapeutic measures before diagnostic procedures can be undertaken with safety. Thus, reliance may have to be placed on a history of ulcer-like distress or of the occurrence and severity of

5. Berkman, J. B.: Gastro-Intestinal Hemorrhage of Indeterminate Origin, Proc. Staff Meet., Mayo Clin. **7**:292, 1932.

6. Jankelson, I. R.: Massive Hematemesis of Undetermined Origin, Gastroenterology **10**:96, 1945.

7. Wheritt, B. H., in Bockus, H. L.: Gastroenterology, Philadelphia, W. B. Saunders Company, 1943.

8. Bennett, T. I.; Lander, F. P. L., and Wright, S.: Severe Hemorrhage of the Stomach and Duodenum, Lancet **2**:650, 1938; **1**:551, 1942.

9. Cullinan and Price, cited by Witts, L. J.: Ritual Purgation in Modern Medicine, Brit. M. J. **1**:447, 1937.

previous episodes as supplied by relatives or associates. Physical examination may have to be restricted to observation of the pulse rate and blood pressure, inspection of the patient and light palpation of the abdomen.

First Stage Emergency Treatment. — Shock: In gastrointestinal hemorrhage, the first essential is to form a quick sound estimate of the general condition of the patient and of the amount of blood lost. If shock is impending, as indicated by rapid weak pulse and cold clammy skin, there must be intravenous administration of fluids immediately. The type of fluid administered will depend on availability. Five or 10 per cent dextrose in isotonic solution of sodium chloride may be administered pending the arrival of plasma, which in turn should be replaced by compatible blood as soon as it is available. Conservation of body heat and maintenance of circulation to vital centers by elevation of the foot of the bed, application of external heat and of bandages to the extremities are important accessory items. Sedation, sufficient to control restlessness and apprehension, is important. The best opinion seems to be that since morphine compounds may aggravate vomiting and a diseased liver may not be able to detoxify it, a barbiturate or some other alkaloid should be used.

Blood Transfusion.—The most important single procedure in the treatment for massive hemorrhage is the infusion of blood when indicated. In shock the restoration of volume of blood is mandatory. The blood employed must be compatible. It is best administered by gravity drip in units of 500 cc. While the danger of reaction from transfusion, with its attendant anuria, is slight, its possibility is sufficient reason to reserve the procedure for only those cases in which the indications are definite. The administration of 250 to 500 cc. of one-sixth molar lactate solution prior to the administration of blood is believed to insure alkalinity and thus diminish the possibility of reaction from transfusion. The indications of a decade or more ago of systolic blood pressure of 70, pulse rate 140 and hemoglobin of 50 per cent now are outmoded and replaced by other criteria. At present, it is believed that systolic blood pressure below 90, coupled with a pulse rate of 120, is evidence of continued bleeding and is an indication for replacement of blood. While the danger of reaction from the administration of plasma is less than from the administration of blood, in cases in which there is significantly reduced cell volume, plasma is useless except as a temporary expedient. Parenteral fluids should be given until the urinary output is 1,000 cc. per day, the amounts given varying with the degree of fluid lost by vomiting and sweating. The once popular blood coagulants are of little value and now may be considered obsolete. Ten to 30 cc. of heterologous

human serum may be injected intramuscularly. In cases in which there is associated hepatic damage or disease, vitamin K may be administered every four to eight hours.

Debatable procedures traditionally used in older methods of treatment included the ice cap, which probably is not rational. Gastric lavage rarely is indicated, except in cases in which there is postoperative hemorrhage and in which washing of the stomach with water at 110 F. has seemed to be of benefit. Application of cold water to the lower part of the esophagus for varicose bleeding has its adherents. The administration of alkalis by mouth and the chewing of gum has been advocated by some, on the assumption that clotting thereby is hastened or digestion of the clot prevented.

Surgical Treatment.—It is not possible for me in this paper to cover the operative treatment for all types of hematemesis and melena except to point out a few general principles. Reference is made elsewhere to my opinion on operation for bleeding peptic ulcer.[10]

Finsterer,[11] Gordon-Taylor,[12] Allen,[13] Heuer[14] and others have endeavored to elaborate principles for surgical treatment for acute massive hemorrhage from peptic ulcer. As the pioneer in this work, Finsterer established the rule that operation must be performed within forty-eight hours and reported that in fifty-two resections the rate of mortality was 3.8 per cent. When operation was deferred until after forty-eight hours had elapsed, the rate of mortality rose to 30 per cent. Since no one else has reported a rate of mortality as low as this, it is apparent that Finsterer utilized operative treatment for all grades of bleeding from peptic ulcer. Allen showed that age is the most important factor in mortality cases in which there is acute hemorrhage. He expressed the belief that this factor is dependent on arteriosclerosis in the wall of the bleeding vessel, whereby its power of contractility is lost. By employing operation within seventy-two hours, limiting its use to patients who are 45 years of age or over and utlizing a special technic of exposure in ideal surgical surroundings, this author reported 1 death in a series of 9 cases. While this rate of mortality is high as compared with the general results of

10. Thompson, H. L.: The Complications of Peptic Ulcer, J. A. M. A **136**:752 (March 13), 1948.

11. Finsterer, H.: Operative Treatment of Severe Gastric Hemorrhage of Ulcer Origin, Lancet **2**:303, 1936.

12. Gordon-Taylor, G.: The Attitude of Surgery to Hematemesis, Lancet **2**:811, 1935.

13. Allen, A. W.: Acute Massive Hemorrhage from the Upper Gastro-Intestinal Tract, Surgery **2**:713, 1937.

14. Heuer, G. J.: The Surgical Aspects of Hemorrhage from Peptic Ulcer, New England J. Med. **235**:777, 1946.

medical treatment, there is no question that in his and other series a few patients have been saved by operation who otherwise would have died. Moreover, unquestionably, there are a few patients for whom operation with the direct control of bleeding is the only means of saving life. The problem lies in a proper selection of those cases and in the technical execution of the appropriate procedure at operation for a patient who is being supported by blood transfusions, before, during and after operation.

The application of surgical measures after recovery from hemorrhage requires individualization of cases. There is no question that the possibility of death increases with repeated hemorrhages and that with each succeeding hemorrhage the indications for operation become more definite.

Second Stage of Treatment.—The second stage of treatment, starting twenty-four to seventy-two hours after hemorrhage has ceased and lasting until diagnostic procedures may be begun with safety, is one of watchful conservative treatment.

Third Stage of Treatment.—The third stage of treatment is the period preferably after the second or third week, when diagnostic procedures may be begun and carried to completion. In view of the increasing possibility of death following recurrences of hemorrhage from peptic ulcer, operation should be contemplated in this condition after the second hemorrhage. Removal of the ulcer or the ulcerated area is the procedure of choice.

Esophageal Varices.—In cases in which there are esophageal varices feeding should be delayed, because of the danger of mechanical injury to the bleeding vein. If diagnostic esophagoscopy is performed, sclerosing solution should be available for injection into the offending varix. Vitamin K should be given for associated hepatic disease and hypoprothrombinemia.

Esophageal Hiatus Hernia.—For esophageal hiatus hernia with gastritis or ulcer, the treatment is elective operation for repair of the hernia by the abdominal or transthoracic route, as the experience of the surgeon dictates.

Ulcerative Colitis.—In ulcerative colitis, if medical treatment does not control the bleeding within reasonable time, ileostomy or colectomy should be considered.

SUMMARY AND CONCLUSIONS

Certain of the pathologic conditions associated with hematemesis and melena are of surgical significance. This applies not only when

the underlying pathologic condition requires surgical treatment but also when there is severe hemorrhage of undetermined cause. It is believed that when the latter occurs the patient should be under the joint observation of an experienced internist and a competent surgeon. The most frequent cause of hemorrhage from the upper part of the gastrointestinal tract is peptic ulcer. When hemorrhage from this source is sufficiently severe to threaten the patient's life, prompt surgical treatment is indicated for certain groups of patients. In such circumstances the decision must be made early, and the surgeon is in the best position to make such a decision if the patient is under his direct observation. On the other hand, when hematemesis and melena occur in patients in whom peptic ulcer is demonstrable, it must not be assumed that bleeding originates from the ulcer until other causes have been ruled out. In a few cases in which the cause of bleeding after exhaustive investigation remains undetermined, surgical exploration may be warranted as a diagnostic as well as a therapeutic procedure. The pathogenesis, clinical features, indications, contraindications and technic of treatment are discussed.

2202 West Third Street.

DISCUSSION

DR. J. WILLIAM THOMPSON, St. Louis: I am intrigued with the artistic and esthetic sense of my namesake from the Pacific Coast. I do want to check up on him a little bit, in reference particularly to one rather unusual cause of profuse hemorrhage from the gastrointestinal tract, the lower part in particular.

I am presenting 2 cases, of which 1 is the case of my father, who is 80 years old and who survived an experience of extreme exsanguinating hemorrhage from diverticula of the colon, and the other is the case of a patient, aged 75, with an almost identical condition, who died. Postmortem examinations were made in the latter case.

Sudden occurrence of severe massive hemorrhage from the colon is rather unusual, and I have not seen 2 such patients previously. I thought it worth while to call this matter to your attention.

I do not know how well you can see the slide (slide shown), but there are multiple extensive diverticula involving the entire colon from the rectosigmoid junction all the way around to the cecum.

The next slide (slide shown) shows the condition much better. The diverticula, in the descending colon, from which the hemorrhage occurred are apparent.

Another patient (slide shown) had extensive diverticular and comparable symptoms. Severe massive exsanguinating hemorrhage occurred suddenly. This man died, in spite of transfusion and all the attempts to save him. Autopsy was performed, at which time all of his tissues were completely depleted of blood, so that his body had almost an ivory white appearance.

In the descending colon, in the region of the sigmoid and pelvic colon (slide shown) there was a huge blood-sausage-like mass, which was the colon, containing

multiple diverticula. There were numerous openings of the diverticula containing blood, which came from ulcerations of the walls of the diverticula, extending into adjacent blood vessels.

It is conceivable that if a younger person presented this picture of massive severe exsanguinating hemorrhage the surgeon would be tempted to do something in the mechanical way to alleviate this condition. In 2 such old persons, of course, surgical intervention would be questionable, but in younger ones, perhaps if this condition should occur, one might think of attacking the problem in a surgical fashion as a life-saving measure, just as one might attack a comparably severe bleeding duodenal ulcer.

DR. KARL A. MEYER, Chicago: Dr. Thompson has covered the field of hematemesis and melena thoroughly. In discussing his paper, I wish to confine myself to one important aspect, that of bleeding peptic ulcer. In order to avoid controversial issues, I shall give you a few conclusions that evolved from my experience:

1. It is often difficult to be certain that one is dealing with a bleeding peptic ulcer and not with a bizarre type of hemorrhagic condition.

2. If the previous history and roentgenologic determinations indicate bleeding peptic ulcer, it is important that differentiation be made between gastric bleeding and duodenal bleeding. Gastric bleeding is more serious.

3. Much importance must be attributed to the age of the patient. After the age of 45 years the problem is more compelling, for a patient more than 45 frequently never ceases bleeding.

4. Operation should be deserving of consideration in cases in which there are repeated hemorrhagic episodes, in which pain is present before and after hemorrhage, in which hemorrhage occurs after surgical treatment for perforation and in which there is pyloric and duodenal obstruction.

5. In cases in which there is bleeding peptic ulcer, too much stress has been laid on raising the blood pressure. My experience does not bear this out. When a patient has lost a large volume of blood, a large volume of blood must be replaced before any direct attack can be made.

6. In the management of active bleeding, the clots which might plug the bleeding vessel can best be encouraged by active effort to neutralize the gastric acidity night and day. This is one of the advantages of the high protein Meulengracht feeding regimen and a by-product of Sippy's teaching.

7. Only after the volume of blood has been restored, and as many as thirty transfusions have been given before this was accomplished, do I make a direct attack on the bleeding points.

The question of ligation, excision or resection must vary with the ability and judgment of the surgeon.

DR. CLAUDE J. HUNT, Kansas City, Mo.: In cases in which there is massive hemorrhage from lesions in the duodenum and stomach it is often difficult to make a decision as to whether an immediate operation should be done. The age of the patient is a good criterion, but it is not always an infallible one. The younger the patient, the more likely is the bleeding to stop and the less likely is it to be fatal.

However, in 3 cases, 1 of them the case of a fairly young person, there was a fatality. The man was 42 years old, had a massive duodenal hemorrhage and came into the hospital practically exsanguinated. Before adequate steps could be taken to replace the volume of blood and prepare him for exploration, he died. At autopsy a duodenal bleeding point was seen.

The other 2 patients were older—1 was 65 years of age and the other 69. The 65 year old patient was seen about three years previously and was known to have

a duodenal ulcer of long standing. He had previously had small hemorrhages. He came into the hospital after an extensive hemorrhage, was rehabilitated by multiple transfusions and prepared for operation the next morning. During the night he had a massive hemorrhage, and the following morning it looked as though he would not live more than an hour. He was given continuous and numerous transfusions, via both the arm and the leg, and the next morning I performed an exploratory operation.

I opened the duodenum, put a mattress suture in the bleeding duodenal ulcer and did a subtotal gastric resection. The man made a good recovery and has had no trouble with his stomach since.

The other was a patient recently operated on at St. Mary's Hospital in Kansas City, who had been examined roentgenographically two days prior to the operation because she had vomited some blood and had become faint. Later, in the hospital, a massave hemorrhage developed. At noon I saw the patient, and she was white and exsanguinated.

Transfusions were started at once, two at a time, in the arm or the leg. The next day, at 8 a.m., after eleven transfusions, at exploratory operation a large movable tumor mass, which would slide up and down; was observed in the stomach. On opening the stomach, the mass protruded and had a pedicle about the size of the wrist. The tumor was still oozing blood from a venous channel, and the stomach was full of blood. With a clamp on the pedicle, the mass was excised, the pedicle sutured and the stomach closed. The patient made an uninterrupted recovery. The tumor proved to be a benign fibroleiomyoma.

These 2 cases demonstrate the wisdom of immediate action. Both patients were in bad condition, and the outlook was grave. Continuous bleeding, no doubt, would have resulted in death. There were no indications that the bleeding would stop. With multiple transfusions and prompt and radical surgical treatment their lives were saved. In older persons bold and herioc methods are often necessary. These should be undertaken immediately, and operation should not be delayed longer than necessary to rehabilitate the patients to a point where exploration would be possible.

DR. HAROLD LINCOLN THOMPSON, Los Angeles: I purposely avoided discussion of the surgical treatment of bleeding peptic ulcer. Anvone who is interested in my views on this phase on the subject I would refer to THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, March 13, page 752.

GASTROJEJUNAL ULCER: CLINICAL FEATURES AND LATE RESULTS

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FOR MANY years gastrojejunal ulcer has constituted one of the major complications in the surgical treatment of duodenal ulcer. In fact, the possible occurrence of this lesion has been so important a consideration that it has been a significant factor in the development of various surgical procedures designed for the treatment of duodenal ulcer. Thus, although a procedure such as gastroenterostomy results almost uniformly in healing of the duodenal ulcer, it has been abandoned largely because of the relatively high incidence of jejunal ulcer which follows its use. Obviously, the patient it not benefited by elimination of an ulcer in the duodenum if one develops in the jejunum.

Until recently the treatment of jejunal ulcer has been fairly well standardized. Excision of the jejunal ulcer associated with high resection of the stomach has been recognized as the procedure most frequently followed by good results. Few have questioned the physiologic basis of this type of treatment. With the advent of vagotomy, however, some surgeons have come to believe that all jejunal ulcers should be treated only by section of the vagus nerves which supply the stomach. A more conservative group has suggested that only those jejunal ulcers which develop after partial gastrectomy should be treated in this manner.

In order to have a basis for comparison of the relative value of partial gastrectomy and vagotomy in the management of jejunal ulcer, it appeared worth while to review the results that have been obtained in the treatment of jejunal ulcer prior to the use of vagotomy. By this means one can derive some opinion regarding how

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effective vagotomy must be in order to supplant partial gastrectomy. With this thought in mind, data on 283 patients with jejunal ulcer who were operated on in the Mayo Clinic from 1937 to 1942 have been reviewed and as many of the patients as possible have been followed up to determine the late result. In some cases follow-up information was obtained by letter, but in many cases subsequent examination of the patient permitted direct evaluation of the result. All patients were followed up a minimum of five years and some for as long as ten years. Although the main purpose of this study is to present the late results obtained in these cases, certain of the clinical features of jejunal ulcer will be discussed. Immediate results obtained in a limited number of cases in which vagotomy was performed for jejunal ulcer are mentioned, although this experience has been too brief to permit any significant conclusions.

CAUSATION AND INCIDENCE

It is now generally agreed that the cause of jejunal ulcer is similar to that of duodenal ulcer. Thus, the former lesion is seen almost exclusively in patients in whom some form of gastrojejunal anastomosis has been established for the treatment of duodenal ulcer. In these patients gastric juice has been diverted in whole or in part from the duodenum into the jejunum, sometimes with the result that ulceration occurs subsequently in the jejunum. The digestive action of the acid-pepsin content of gastric juice, which is so pronounced in cases of duodenal ulcer, may thus exert a deleterious effect on the jejunum. In substantiation of this viewpoint it is known that jejunal ulcer seldom, if ever, develops after palliative gastroenterostomy or gastric resection performed for carcinoma of the stomach, as in these circumstances the acid-pepsin factor in gastric juice generally is of small magnitude. Likewise, at least in this country, jejunal ulcer seldom is observed after partial gastrectomy for gastric ulcer or, for that matter, after local excision of a gastric ulcer associated with gastroenterostomy. In the present series of 283 cases, the antecedent lesion was duodenal ulcer in 92.5 per cent of cases and gastric ulcer in 1.4 per cent. In 0.7 per cent the jejunal ulcer occurred some years after gastroenterostomy for hypertrophic pyloric stenosis, and in 5.3 per cent the original lesion was merely termed "peptic ulcer" or was unknown.

The incidence of jejunal ulcer following gastroenterostomy for duodenal ulcer has been variously reported in the literature. Some years ago, surgeons[1] of experience reported an incidence as low as 1.2 to 3.5 per cent. In later years it became apparent that the incidence was much higher, and it has been reported to be as high as

34 per cent.[2] Obviously, there are numerous factors to account for such wide variations in the reported frequency of this lesion. Among these may be mentioned selection of patients for operation, relative incidence of all patients with duodenal ulcer who are treated surgically, type of gastroenterostomy performed, length of follow-up, accuracy of follow-up and so forth. One lesson which may be drawn from the long period required for at least a relatively accurate evaluation of gastroenterostomy is a realization of the time and care which are necessary for a true evaluation of any new procedure which may be suggested for the treatment of duodenal ulcer. Hasty deductions, even though based on apparently sound physiologic observations, are hazardous, to say the least. Currently, an average incidence of jejunal ulcer following gastroenterostomy for duodenal ulcer, as reported in the literature, is approximately 15 per cent. In a carefully selected series of cases, however, the incidence may be appreciably lower. In the present series of cases, 93.2 per cent of the jejunal ulcers followed gastroenterostomy and 6.8 per cent occurred after partial gastrectomy. These figures, of course, afford no significant information concerning the frequency of jejunal ulcer after either type of operation.

At is became apparent that simple gastroenterostomy is an inadequate operation in most cases of duodenal ulcer, gastric resection came into widespread use. Unfortunately, this operation has not completely prevented the development of jejunal ulcer. The reported incidence of jejunal ulcer following partial gastrectomy varies from 0 to 9 per cent or higher.[3] Again, certain variables must exist to ac-

1. (*a*) Judd, E. S., and Hoerner, M. T.: Jejunal Ulcer, Ann. Surg. **102**:1003-1018 (Dec.) 1935. (*b*) Moynihan, B.: A Clinical Lecture on Disappointments After Gastroenterostomy, Brit. M. J. **2**:33-36 (July 12) 1919. (*c*) Paterson, H. J.: Discussion on the Place of Gastro-Jejunostomy in Gastric and Duodenal Surgery, ibid. **2**:555-557 (Sept. 25) 1926. (*d*) Walton, A. J.: Gastrojejunal Ulceration, Brit. J. Surg. **22**:33-35 (July) 1934. (*e*) Wilkie, D. P. D.: Jejunal Ulcer; Some Observations on Its Complications and Their Treatment, Ann. Surg. **99**:401-409 (March) 1934. (*f*) Heuer, G. J.: The Choice of Operations in the Treatment of Peptic Ulcer, New York State J. Med. **35**:1-9 (Jan. 1) 1935.

2. Lewisohn, R.: The Frequency of Gastrojejunal Ulcers, Surg., Gynec. & Obst. **40**:70-76 (Jan.) 1925.

3. (*a*) Hinton, J. W.: The Intractable Duodenal Ulcer; Evaluation of Surgical Procedures, Ann. Surg. **117**:498-511 (April) 1943. (*b*) Steinberg, M. E.: Reoperative Surgery for Recurrent Peptic Ulcerations, Surg., Gynec. & Obst. **84**:1029-1037 (June) 1947. (*c*) Wangensteen, O. H.: Causes of Failure After Gastric Resection for Ulcer; The Myth of the Intractable Ulcer Together with a Note Concerning the Importance of the Vascular Factor in the Genesis of Ulcer, Wisconsin M. J. **44**:878-888 (Sept.) 1945. (*d*) Colp, R., in discussion on Wilkinson, S. A.: The Obstructed Peptic Ulcer, Am. J. Digest. Dis. **9**:324-325 (Oct.) 1942. (*e*) Rienhoff, W. F., Jr.: Analysis of Results of the Surgical Treatment of Two Hundred and Sixty Consecutive Cases of Chronic Peptic Ulcer of the Duodenum, Ann. Surg. **121**:583-599

(Footnotes continued on next page)

count for such divergent results. For the most part results following a "high" resection are superior to those following a "low" resection. The incidence of jejunal ulcer following gastroenterostomy associated with vagotomy remains to be determined, and, undoubtedly, more time is required before an average figure can be obtained. The length of time required for the development of a jejunal ulcer may vary from a few months to twenty-five years or more. Allen and Welch[4] have stated that a third of the jejunal ulcers occur within the first year after operation, a third during the second year and the remainder at a later time. Most authors are in agreement with this generalization. In the present study, in 56 per cent of cases symptoms developed within two years after operation for duodenal ulcer. The average time that elapsed before the development of recurrent symptoms after gastroenterostomy was three and seven-tenths years; however, it was only one and seven-tenths years after gastric resection for duodenal ulcer.

PREVENTION

Probably the most important aspect of jejunal ulcer is its prevention. Although the cause of jejunal ulcer is fairly well understood, its complete prevention has not proved to be a simple matter, and, in all likelihood, these ulcers will be encountered for some time to come. Certain operations for duodenal ulcer are more effective than others in preventing jejunal ulcer. Thus, it is well known that the greatest number of jejunal ulcers have occurred after gastroenterostomy performed for duodenal ulcer.

Certain factors are considered of primary importance in the prevention of duodenal ulcer, and others are considered to be of secondary or questionable importance. Thus, it has been repeatedly demonstrated, both experimentally and clinically, that the operation which is followed least often by jejunal ulcer is a gastric resection of sufficient magnitude to effect achlorhydria. Unfortunately, it is difficult or impossible for the surgeon to be sure in each case just how much

(May) 1945. (*f*) Kiefer, E. D.: Jejunal Ulcers and Recurrent Hemorrhages After Partial and Subtotal Gastrectomy for Peptic Ulcer, J.A.M.A. **120**:819-824 (Nov. 14) 1942. (*g*) St. John, F. B.: A Follow-Up Study of the Results in Surgical Therapy for Gastric and Duodenal Ulcer, Tr. Am. S. A. **48**:162-166, 1930. (*h*) Gatewood: The Immediate Mortality and Late Results of Operation for Peptic Ulcer Performed in the Presbyterian Hospital of Chicago Between 1915 and 1930, ibid. **48**:142-145, 1930. (*i*) Klein, E.; Aschner, P. W., and Crohn, B. B.: The End-Results of Partial Gastrectomy for Primary Gastric and Duodenal Ulcers: Studies in Pre- and Post-Operative Gastric Secretion, Tr. Am. Gastro-Enterol. A., 1933, pp. 197-205.

4. Allen, A. W., and Welch, C. E: Gastric Resection for Duodenal Ulcer: Follow-Up Studies, Ann. Surg. **115**:530-543 (April) 1942.

of the stomach must be resected to effect such a reduction of gastric acidity. In fact, it has been virtually impossible for the surgeon to be certain exactly what percentage of the stomach is removed when partial gastrectomy is performed. Current work by Heinrich[5] may offer an answer to this problem. Wangensteen[6] has stated that it is necessary to remove 180 Gm. of stomach, if there is no pyloric obstruction, to effect achlorhydria, and this seems to be generally true although there seem to be exceptions. Many agree that approximately three quarters of the stomach must be removed to accomplish this purpose. On the other hand, the patient is not altogether uncommon who has an appreciable gastric acidity perhaps when only a sixth or a seventh of his stomach remains after several resections for recurrent ulcer. Although the amount of stomach resected probably is the most important single factor in the prevention of recurrence, certain other considerations also are significant.

Thus, it has been observed repeatedly that an exclusion type of operation, whereby the stomach is severed proximal to the pylorus and the prepyloric segment is allowed to remain in place, is followed by a high incidence of jejunal ulcer.[7] If the modification of this operation suggested by Bancroft or McKettrick is employed, whereby the mucosa in the pyloric antrum is excised, the incidence of jejunal ulcer may be reduced, although we know of no significant series of cases of this type that have been reported from this point of view.

It is now generally agreed that in making a gastrojejunal anastomosis a short proximal loop of jejunum is preferable to a long loop. Kolouch[8] has presented evidence to suggest three possible reasons for this observation: (1) decrease of resistance to acid-pepsin digestion of the segments of the intestinal mucosa farther from the pylorus, (2) appreciable absorption of duodenal juices in the upper part of the jejunum, so that as a gastrojejunal anastomosis is placed more distally in the jejunum a smaller amount of duodenal juices is available to dilute, neutralize or buffer the acid gastric juice, and (3) a distally placed anastomosis may result in less effective stimulation of the flow of bile and pancreatic juice. Performance of a posterior type of gastrojejunal anastomosis permits use of a shorter proximal loop of jejunum than when an anterior anastomosis is established.

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5. Heinrich, W. A.: Personal communication to the authors.

6. Wangensteen, O. H.: The Criteria of a Satisfactory Operation for Ulcer and Causes of Failure After Gastric Resection for Ulcer, Minnesota Med. **28**:66-67 (Jan.) 1945.

7. Allen and Welch.[4] Kiefer, E. D., cited by Hinton.[3a]

8. Kolouch, F., Jr.: Evaluation of the Short Proximal Loop in Gastric Resection, Thesis, Univerity of Minnesota, Minneapolis, unpublished.

Some difference of opinion exists regarding the actual necessity of removing the duodenal ulcer at the time when gastric resection is performed. Some surgeons[9] have expressed the belief that complete removal of the ulcer is unimportant, as long as a satisfactory closure of the duodenal stump is obtained, but not all agree.[3a] Probably all will agree that the procedure of choice, when practical, consists in removal of the ulcer and closure of the duodenum distal to the area of ulceration. At times, however, a perforating ulcer located deep in the descending portion of the duodenum may be in such proximity to the common bile duct as to involve injury to the latter or require its transplantation if the ulcer is removed. In our opinion such a procedure is not justified. In some cases the duodenum may be severed immediately distal to the pylorus and closed proximal to the ulcer. In other cases, the duodenum may be severed at the level of the ulcer and the crater of the latter may be permitted to remain on the pancreas. So far as we know, a duodenal ulcer which is left in place invariably will heal, provided that a satisfactory resection is performed. There is no evidence to show that this ulcer increases the incidence of subsequent jejunal ulceration.

The operation which theoretically should afford the greatest protection against jejunal ulcer is high gastric resection associated with vagotomy. Such a procedure seldom seems indicated for the ordinary patient on whom operation is performed for duodenal ulcer; however, in the exceptional case it may be advisable.

DIAGNOSIS

Usually the diagnosis of jejunal ulcer is not difficult. Given a patient who has undergone gastroenterostomy or gastric resection for duodenal ulcer and who shows recurrent symptoms, one should suspect jejunal ulcer. If, in association with these symptoms, bleeding occurs, a presumptive diagnosis of jejunal ulcer can be made. Functional dyspepsia, a malfunctioning stoma, gastritis and, rarely, gastric carcinoma must be excluded.

There are some differences usually between the symptoms of duodenal and of jejunal ulcer. Thus, probably because of the location of the lesion, the pain associated with jejunal ulcer frequently is located more to the left and lower than that caused by duodenal ulcer. Pain occurs frequently at night and may be less readily relieved by food or alkali, probably because of the frequent tendency to perforation. Some degree of perforation is commoner in the secondary type of ulceration and was noted in 54 per cent of the present series of cases. Likewise, bleeding occurs oftener in jejunal ulcer and was

9. Colp.[3d] Rienhoff.[3e]

observed in 45 per cent of cases. As a result, anemia is common. In contrast, obstruction develops less frequently and was noted in only 15 per cent of cases.

Analysis of gastric contents invariably reveals hydrochloric acid, provided that a specimen is obtained which does not contain too large a quantity of duodenal juices. The most accurate, although not infallible, diagnostic aid is roentgenologic examination following ingestion of barium. Positive observations were noted in 86 per cent of 271 cases in which this examination was conducted, but in only 52 per cent was a definite diagnosis of jejunal ulcer made. Eusterman, Kirklin and Morlock[10] have stated that in approximately 77 per cent of cases in which there is a nonfunctioning gastroenteric stoma definite jejunal ulceration is seen at the time of operation. Gastroscopic examination may be of value, but a negative result of gastroscopic examination should not be considered significant, as frequently the jejunal ulcer is situated in the jejunum distal to the stoma and beyond the range of view afforded to the gastroscopist. Tosseland and McDonald,[11] in a study of 100 cases of pathologically proved gastrojejunal ulcers, observed the lesion in the jejunum in 81 per cent of cases and in only 3 per cent in the stomach. In the remaining cases the exact site could not be determined.

COMPLICATIONS

The complications of jejunal ulcer are hemorrhage, perforation and gastrojejunocolic fistula. These will not be discussed in detail. As mentioned, hemorrhage is commoner in jejunal than in duodenal ulcer. However, probably because of the location of the ulcer, which makes rupture of a large vessel unlikely, hemorrhage from a jejunal ulcer seldom is fatal, in contrast with duodenal ulcer. Frequently blood may be detected in the stool. Again, some degree of perforation is commoner than in duodenal ulcer, although free perforation into the peritoneal cavity is unusual. A few such cases have been reported.[12] Again, this is probably because of the location of the

10. Eusterman, G. B.; Kirklin, B. R., and Morlock, C. G.: The Nonfunctioning Gastro-Enteric Stoma: Diagnostic Study of Sixty-Two Surgically Demonstrated Cases, Am. J. Digest. Dis. **9**:313-317 (Oct.) 1942.

11. Tosseland, N. E., and McDonald, J. R.: Ulcerating Lesions of the Gastro-Enteric Stoma, Arch. Surg. **51**:113-119 (Sept.) 1945.

12. Braun, H.: Demonstration eines Präparates einer II Monate nach Aüsführung der Gastroenterostomie-entstandenen Perforation des Jejunum, Verhandl. d. deutsch. Gesellsch. f. Chir. **28** (pt.2) :94-97 (April) 1899. Warren, K. W., and Pallis, L. S.: Perforation of Post-Operative Jejunal Ulcers, Surgery **15**:569-573 (April) 1944.

lesion in proximity to adjacent structures, which affords protection against free perforation.

The most serious complication, of course, is gastrojejunocolic fistula, which has been reported as occurring in 8.7 to 18.1 per cent of cases.[13] In the present series the incidence was 11.4 per cent. Obviously, it is desirable to perform operation for jejunal ulcer before this complication develops. Many times an impending gastrojejunocolic fistula will be discovered at the time of operation. The clinical features and treatment of this lesion require too prolonged a discussion to include at this time.

TREATMENT AND OPERATIVE MORTALITY RATE

Although it has been suggested in the past that medical treatment should be tried in all cases of jejunal ulcer before surgical intervention is advised, few still adhere to this view. If medical treatment was unsuccessful in obviating surgical treatment of the duodenal ulcer, there seems little reason to expect that it would be more effective in management of the jejunal ulcer. In our opinion, once the diagnosis of jejunal ulcer has been established, surgical intervention should be advised, provided that the patient's general condition permits.

The surgical treatment of jejunal ulcer has undergone a process of gradual evolution over a period of many years. For the sake of clarity, the jejunal ulcer which develops after gastroenterostomy will be considered first. The operation used for this lesion some years ago consisted in excision of the jejunal ulcer and disconnection of the gastroenteric anastomosis with or without associated pyloroplasty. Forty-two of the 244 patients operated on at the Mayo Clinic between the years 1937 and 1942 for jejunal ulcer which occurred after gastroenterostomy had this type of operation performed. The mortality rate in this group was 4.8 per cent (table 1). Obviously this procedure restored the gastrointestinal tract to a status similar both anatomically and physiologically to that which existed when the duodenal ulcer was active.

Gradually it became apparent that something further was necessary, so that for some years partial gastrectomy performed at the time when the jejunal ulcer was excised became the operation of choice. Until recently this has constituted the more or less standard operation for jejunal ulcer, the posterior Polya type of partial gastrectomy being the procedure employed most frequently in our experience. In

13. Judd and Hoerner,[1a] Klingenstein, P.: Gastrojejunocolic Fistula, S. Clin. North America **27**:315-331 (April) 1947. Ransom, H. K.: Gastrojejunocolic Fistula, Surgery **18**:177-190 (Aug.) 1945. Walters, W., and Clagett, O. T.: Gastrojejunocolic Ulcer and Fistula, Am. J. Surg. **46**:94-102 (Oct.) 1939.

the present series of 244 cases in which jejunal ulcer followed gastroenterostomy, partial gastrectomy was employed in 196 cases. In 169 of these cases partial gastrectomy of the posterior Polya type was done, with a mortality rate of 2.9 per cent, and in the remaining 27 cases some other type of partial gastrectomy was performed, with a mortality rate of 7.4 per cent (table 1).

The surgical mortality rate for the entire 244 cases was 4.0 per cent (table 2). It might be added that the surgical mortality rate was 11.1 per cent of 18 patients on whom operation was performed for jejunal ulcer which developed after primary partial gastrectomy

TABLE 1.—*Mortality Rate for Operations for Gastrojejunal Ulcer Which Followed Gastroenterostomy*

Operation	Cases	Operative Mortality (Percentage)
Excision of jejunal ulcer; disconnection of gastroenteric anastomosis with or without pyloroplasty	42	4.8
Excision of jejunal ulcer; partial gastrectomy (posterior Polya type)	169	2.9
Excision of jejunal ulcer; partial gastrectomy (other than posterior Polya type)	27	7.4
Miscellaneous procedures	6	33.3

TABLE 2.—*Operative Mortality in the Treatment of Jejunal Ulcer and Gastrojejunocolic Fistula*

	Cases	Operative Mortality (Percentage)
Gastrojejunal ulcer after gastroenterostomy	244	4.1
Gastrojejunal ulcer after gastric resection	18	11.1
Gastrojejunocolic fistula	21	19.0

for duodenal ulcer and 19 per cent for 21 patients on whom various types of operation were performed for gastrojejunocolic fistula (table 2).

During the last few years, many articles dealing primarily with the use of vagotomy in the treatment of duodenal ulcer have included mention of a few cases in which this procedure has been employed in the treatment of jejunal ulcer. From a physiologic point of view it would seem that vagotomy is a sound procedure in the management of jejunal ulcer which follows partial gastrectomy. This is true, provided that the pyloric antrum was removed and a reasonable amount of the stomach was resected when the partial gastrectomy was performed. If one recalls the three phases of gastric secretion, the psychic, gastric and intestinal, it is apparent that at least the major

portion of the second or gastric phase is eliminated by partial gastrectomy. In fact, the treatment of duodenal ulcer by partial gastrectomy is predicated on this assumption. If, despite this reduction in gastric acidity, jejunal ulcer develops, it appears logical as a next step to eliminate the first or psychic phase by means of vagotomy. In our opinion the most definite indication for vagotomy exists in this type of case. Physiologically a somewhat less definite indication for vagotomy exists in the treatment of jejunal ulcer that develops after gastroenterostomy. In these circumstances the only actual reduction of gastric acidity which occurs results from elimination of the first phase of gastric secretion. In other words, the situation is analogous to the treatment of duodenal ulcer by means of simultaneous vagotomy and gastroenterostomy.

From Jan. 1, 1946 through Oct. 31, 1947, vagotomy has been performed in the Mayo Clinic in 44 cases of proved jejunal ulcer. In 20 of these cases, vagotomy was performed for jejunal ulcer which developed subsequent to gastroenterostomy. In 14 of these 20 cases abdominal vagotomy was carried out, and in half of these cases some associated procedure on the stomach and jejunum was performed. In 6 of the 20 cases thoracic vagotomy alone was employed. In 24 of the entire group of 44 cases, vagotomy was used in the treatment of jejunal ulcer which developed after primary partial gastrectomy. In 15 of these the thoracic approach was used, and in the remaining 9 the abdominal route was employed. No significant associated procedure was performed in any of these cases. There was no postoperative death in the group of 44 cases.

RESULTS

In considering results of treatment for jejunal ulcer, one should differentiate between the jejunal ulcer which follows gastroenterostomy and the ulcer which develops after primary partial gastrectomy for duodenal ulcer. Regarding jejunal ulcer which follows gastroenterostomy, it may be said that results in the treatment of this lesion are not satisfactory if a conservative operation is performed, such as excision of the ulcer and disconnection of the gastroenteric stoma, with or without an associated plastic operation on the outlet of the stomach. Thus, of 35 patients who had this type of operation and who were followed up for five to ten years postoperatively, only 14.3 per cent obtained a satisfactory result (table 3). In 85.7 per cent the result was unsatisfactory, and in 31.4 per cent subsequent operation was required. In contrast with the results obtained by this type of treatment, a far superior prognosis was obtained if the jejunal ulcer was excised and partial gastrectomy of the posterior Polya type was per-

formed. In these circumstances the results five to ten years after operation in a group of 103 patients were satisfactory in 87.4 per cent and unsatisfactory in only 12.6 per cent of patients (table 3). In the small number of 17 patients on whom partial gastrectomy of types other than a posterior Polya type was performed, results were less satisfactory.

If one considers the entire group in which jejunal ulcer occurred after gastroenterostomy, it is seen in table 4 that of 159 patients who were followed up for five to ten years, 67 per cent obtained a satisfactory result, 33 per cent experienced recurrent symptoms and further operation was necessary in 14 per cent. None of the foregoing figures take into account a small number of patients who died during the period of follow-up of causes unrelated to the upper part of the gastrointestinal tract. Obviously, the best results in the management of this type of lesion have been obtained by excision of the ulcer with simultaneous partial gastrectomy of the posterior Polya type.

TABLE 3.—*Results of Operation for Gastrojejunal Ulcer Which Followed Gastroenterostomy*

Operation	Cases*	Results (Percentage of Cases)			
		Satisfactory	Died of Unrelated Cause	Recurrence of Symptoms	Subsequent Operation
Excision of jejunal ulcer and disconnection of gastroenteric anastomosis with or without pyloroplasty	35	14.3	0	85.7	31.4
Excision of jejunal ulcer; partial gastrectomy (posterior Polya type)	103	87.4	8.3	12.6	5.8
Excision of jejunal ulcer; partial gastrectomy (other than posterior Polya type)	17	64.7	11.1	35.3	5.9
Miscellaneous procedures	4	25.0	0	75.0	50.0

*Follow-up data obtained for five to ten years in all cases.

The recurrent ulcer which develops after primary partial gastrectomy for duodenal ulcer always has presented a formidable problem from the point of view of treatment. In a small series of 11 patients with a lesion of this type, slightly more than half obtained a satisfactory result (table 4). Although this group of cases is too small to be significant statistically, it does support the clinical impression which has been held by many surgeons, that jejunal ulcer which occurs after gastric resection is more difficult to treat than the same type of lesion which follows gastroenterostomy.

Results of treatment of gastrojejunocolic fistula have been disappointing. Not only has the operative mortality rate been high, but ultimate results have been poor. Thus, of 13 patients followed five to ten years after operation for this condition, only 4 (table 4) obtained a satisfactory result. It is of some interest, however, that 3 of

these 4 patients had a posterior Polya type of resection performed at the time when the fistula was excised and that only 1 patient who had this type of operation performed, on whom follow-up information was obtained, showed symptoms of recurrence.

Unfortunately, no report can be given at this time on results after vagotomy except to mention briefly the immediate postoperative course in these patients. Of the 20 patients who had jejunal ulcer following gastroenterostomy and who underwent abdominal vagotomy, with or without an associated procedure on the stomach and jejunum, all but 1 were free of any significant abdominal symptoms a few weeks after operation. One patient returned a few months after operawith a recurrent ulcer in the duodenum, subsequent to vagotomy and restoration of normal gastrointestinal continuity by disconnection of the gastroenteric stoma. It is of interest that although the roentgenologist reported preoperatively a malfunctioning gastroenteric stoma in 6 of the 20 cases, vagotomy alone was not necessarily followed by

TABLE 4.—*Late Results of Treatment of Jejunal Ulcer and Gastrojejunocolic Fistula*

Lesion	Cases*	Results of Treatment (Number of Cases)		
		Satisfactory	Died of Unrelated Causes	Subsequent Operation
Gastrojejunal ulcer after gastroenterostomy	159	106	17	22
Gastrojejunal ulcer after gastric resection	11	6	2	2
Gastrojejunocolic fistula	13	4	2	4

*Follow-up data obtained for five to ten years in all cases.

any disturbance of gastric emptying that was manifested clinically. In 19 of the 24 patients who underwent vagotomy for jejunal ulcer which developed subsequent to partial gastrectomy, the immediate postoperative course was satisfactory. Of the remaining 5 patients in this group, 1 became free of symptoms shortly after operation but returned eight months later with recurrent symptoms and roentgenologic evidence of jejunal ulcer. One patient has had persistent symptoms of ulcer, and another has bled, presumably from a persistent jejunal ulcer. The 2 remaining patients of the 5 who had unfavorable early postoperative results experienced annoying symptoms of motor disturbance. The result of the insulin test was definitely positive in 4 of the entire group of 44 cases.

SUMMARY

The cause of jejunal ulcer is similar to that of duodenal ulcer. The routine use of gastroenterostomy in the treatment of duodenal

ulcer is followed by a relatively high incidence of jejunal ulcer. Similar use of moderately high gastric resection with complete removal of the pyloric antrum is followed by a low incidence of jejunal ulcer. The ultimate frequency of jejunal ulcer after vagotomy and gastroenterostomy remains to be determined. Prevention is of paramount importance in any consideration of jejunal ulcer. Diagnosis of this lesion usually is not difficult. The complications are hemorrhage, perforation and gastrojejunocolic fistula.

Treatment of jejunal ulcer is primarily surgical. To date the best results have been obtained by disconnection of the gastroenteric stoma, excision of the jejunal ulcer and adequate gastric resection of the posterior Polya type. With this type of treatment results are satisfactory over a period of five to ten years in approximately 87 per cent of patients who have undergone previous gastroenterostomy. Results are less satisfactory if the original operation was partial gastrectomy. From a physiologic point of view vagotomy would seem to be a sound procedure if the original operation was partial gastrectomy. Late results of vagotomy in the treatment of jejunal ulcer remain to be determined. Of 44 cases in which this procedure was performed, the immediate results have been good in 19 of 24 cases in which vagotomy was performed for jejunal ulcer that developed after partial gastrectomy and in 19 of 20 cases in which jejunal ulcer developed after gastroenterostomy.

DISCUSSION

OF PAPERS BY DRS. WAUGH AND CLAGETT, M'NEALY, AND PRIESTLEY AND GIBSON

DR. ROBERT L. SANDERS, Memphis, Tenn.: Pursuing the subject of vagal resection, about which I talked to some of you in Memphis, (1946), I shall limit my remarks to the paper by Drs. Priestley and Gibson.

At the time of the last meeting, my colleagues and I had performed only fifteen vagal resections. Thus far, we have performed eighty-six on private patients and seventeen on the gastroenterologic service at the University of Tennessee Hospital, making a total of one hundred and three operations. This is not an astronomic figure, yet the number has been sufficient to permit a few significant observations.

Of the 86 private patients, 50 were operated on more than three months ago. Five of the 50 had gastrojejunal ulcers, while 45 had duodenal ulcers. In only a few cases have we employed vagal resection for gastric ulcer, and then solely as an adjunct to gastric resection.

Of these 50 patients, 94 per cent have been benefited by the operation. Of the 5 who had stomal ulcer, all have obtained good results. Thirteen of those with primary duodenal ulcer had a vagal resection alone. The result was unsatisfactory in 3 of the 13. In addition, 5 patients in this group continued to have some digestive difficulty incident to gastric atony and retention. The remaining 5 have been completely relieved following a short period postoperatively wherein they were troubled with mild digestive disturbances.

Of the 32 patients who had gastroenterostomy in connection with vagal resection, 29 have obtained good results, 2 fair results, and 1 has had a poor result. In the last case, the gastroenterostomy was performed four months after vagal resection. We feel that the failure of the operation in this case may be explained largely by the fact that the patient was definitely neurotic.

A comparison of the results of vagal resection alone with those of vagal resection with gastroenterostomy for primary ulcer shows that 38.5 per cent of the patients who had the former operation obtained a good result, whereas, of those who had the combined operation, 90 per cent had a good result. Undoubtedly, the more favorable outcome in the latter group may be attributed to the increased emptying time of the stomach.

Our view as to the desirability of the abdominal approach in preference to the thoracic approach has been strengthened as our experience has increased. We feel that visualization of the operative field is preferable, in that one may thus determine the exact nature of the disease. In a considerable number of cases, the clinical and roentgenographic studies are misleading, and, without opening the abdomen, one is likely to make the mistake of performing a vagal resection unnecessarily on occasion or to omit necessary operation. The observation of mere pylorospasm, mild duodenitis or a gastric rather than a duodenal lesion alters materially the surgical indications. Not only this, but pulmonary complications are less likely following the abdominal approach. Only 3 of our patients had pulmonary complications, and in all 3 these were of mild degree.

Thus far, healing of the ulcers has been evidenced roentgenographically and clinically in more than half these cases, and the acids have remained low. Whether the acids will rise later, or, if they rise, whether they will reactivate the old ulcer or produce a new one, is uncertain. To the present time, our experience with this new approach to the treatment for ulcer has been gratifying.

DR. J. M. WAUGH, Rochester, Minn.: I should like to point out that there is never any necessity for "forcing" this particular modification of the Billroth I operation. The Hofmeister-Polya procedure can be substituted readily for the Schoemaker-Billroth I if, after mobilization and resection of the stomach, the remnant is seen to be too small safely to reach the duodenum. It has been our practice to proceed with as radical a resection as seems indicated for the lesion present; then, if the remnant of stomach cannot be brought to the duodenum without tension, the duodenum is closed and the stomach is joined to the jejunum, with the Hofmeister modification of the posterior Polya type of operation.

The Schoemaker-Billroth I operation most frequently will be found to be ideal for patients who have gastric ulcer, for in such a case the duodenum is normal and frequently is pulled to the left by the contracted and fixed stomach. Often it will also be possible to use the procedure to advantage for the patient who has a carcinoma of the lower third of the stomach. If there is extensive malignant involvement and fixation about the pylorus, I think that it is best not to use this particular operation, even though it may be accomplished readily, for, if recurrence of the malignant process does result, it is likely that there will be late obstruction of the stoma, which might have been avoided had the Polya technic been used, because the Polya operation places the stoma well to the left of the head of the pancreas. In other words, when used advisedly, one operation is just as curative as the other so far as the malignant lesion is concerned, for the resected area is the same, but, if recurrence around the head of the pancreas is a possibility, the Hofmeister-Polya procedure would be expected to effect more palliation. Up to the present, we know of no instance in which late obstruction

has appeared in any patient on a basis of recurrent malignant growth at the site of gastroduodenostomy.

As a primary operation for duodenal ulcer, the surgeon rarely can carry out adequate resection of the stomach and complete the anastomosis without tension, because the scarring, narrowing or fixation of the duodenum will not permit it. For jejunal ulcer, because the original duodenal ulcer usually is healed and the duodenum may be mobile, the Schoemaker-Billroth I operation can be used oftener. It is important to point out, however, that resection of 75 per cent of the stomach is advisable for patients who have recurrent ulcer, whether it be accomplished by the Billroth I or the Polya type of procedure. Apparently, use of the Billroth I operation requires no less extensive resection, as we originally believed, for I know of recurrent duodenal ulcers that developed in 2 patients of my own who had undergone resection of 60 per cent of the stomach.

When it can be used, the Schoemaker-Billroth I operation is an ideal procedure for the patient who is aged or in whom operation constitutes a poor risk, and the operation would appear to us to be accompanied with a definitely lower rate of mortality for this group of patients. A protograph made of the gross specimen removed from an 89 year old woman well illustrates this point (a slide from the photograph was shown). Obstruction was complete, and the patient was bedfast. I carried out a gastric resection, using the Billroth I technic, with the patient under the influence of local anesthesia. She made a satisfactory recovery and lived for two years. To my knowledge, she was the oldest patient to have undergone gastric resection successfully. (Slides concerning illustrative cases of gastric ulcer, malignant lesions and jejunal ulcer, with preoperative and postoperative roentgenograms of patients who had undergone the Schoemaker-Billroth I procedure were shown.)

Dr. R. Russell Best, Omaha, Neb.: My interest in the Billroth I gastric resection dates back some time and was influenced by my work with Professor von Haberer in 1929 and 1930. There is some misrepresentation of the von Haberer operation, in that in the literature it is stated that the end of the stomach is implanted to the side of the duodenum. In some 400 cases in which I participated at this clinic, there was only 1 in which the end of the stomach was planted in the side of the duodenum. Professor von Haberer practically always anastomosed the end of the stomach to the end of the duodenum, and it was not necessary to add that Hofmeister maneuver. He simply incised through the serosa and muscular layer of the stomach, and then, by insertion of a group of interrupted sutures in the mucosa, a purse-string effect was produced and the end of the stomach was mushroomed over the end of the duodenum.

I was enthusiastic about this procedure. In fact, some of you will recall that at the meeting of the Western Surgical Association in Omaha in 1938, I demonstrated this technic of von Haberer's modification of the Billroth I procedure. However, I have not been enthusiastic about it in late years.

At one time I presented several papers—in about 1932 or 1933—giving the advantages of the Billroth I procedure. However, I wish now to make a few statements regarding the disadvantages, of which I have become aware as a result of my experience in von Heberer's clinic and in several of my own cases.

I doubt whether one would be as radical in doing a resection with a Billroth I type of anastomosis. One is likely to say, "Well, I do not wish to have much tension here and I will just come down another half inch or an inch." I believe that that is just human reaction in performing operations. If the Billroth I type of anastomosis were just as easy and if complications were as few, I believe that many surgeons would have adopted it many years ago.

If ulcer does recur, there is still a gastric duodenal ulcer in the vicinity of the gastroduodenal artery, which is extremely vulnerable as far as severe hemorrhage is concerned.

If a secondary resection is done because of the recurrent ulcer, it is difficult to remove the gastric mucosa which is at the suture line. At least, it was true in my experience, when I had to do one of these secondary operations. Some surgeons have expressed the belief that if any of the gastric mucosa is left one of the purposes of gastric resection is defeated.

My greatest difficulty was with the development of stricture. I saw it occur several times, and 1 patient died at the time of the secondary operation.

The subject of how to choose the site of jejunal anastomosis is well covered in Dr. McNealy's paper. I believe that this is interesting and a definite contribution to those of us who believe in the antecolic type of anastomosis.

I should like to ask Dr. Priestley one question, and I ask this because I am interested in the antecolic operation for one particular reason — when I have to do a secondary resection I have felt that it was easier and that the mortality was less if an antecolic resection anastomosis had been done previously. I should like to know whether he has broken down his figures in the group of cases in which gastric resection was done and in which jejunal ulcer later developed. The rate of mortality was 14 per cent, and I am interested in knowing whether he has broken down his figures, so that one could tell what the mortality was in the group of cases in which previous posterior anastomosis was performed and in the group in which previous anterior anastomosis was performed.

Dr. C. Mathewson, San Francisco: I should like to ask Dr. Priestley, or anyone else here, whether he has employed vagotomy in the treatment of gastrojejunocolic fistula. My colleagues and I recently treated a patient in whom a marginal ulcer developed following gastric resection, and soon thereafter a gastrojejunocolic fistula developed. Following a first stage Lahey procedure his diarrhea ceased, and he gained weight but his pain returned. Because he was an alcoholic addict, extensive operation that was necessary to correct the fistula was risky. We tried a vagotomy as a secondary procedure, and the result to date has been good.

Dr. O. T. Claggett, Rochester, Minn.: I do not believe that I have anything to add. I hope that my experience will not be like that of Dr. Best and that in a few years I will not be discouraged with the procedure. I think that the Shoemaker modification does offer many advantages over the von Haberer operation as I understand it.

I think that an important point about the operation, in the prevention of formation of stricture and obstruction, is that one does not tailor the size of the stomach to meet the size of the duodenum, but one can enlarge the duodenum easily to meet the size of the stomach and have an adequate opening.

From our experience, I do not believe that we need to worry.

Dr. Raymond W. McNealy, Chicago: I purposely did not discuss the indications for the antecolic or the retrocolic anastomosis, but I would like to emphasize that in secondary operation for either inadequate gastroenterostomy when resection is contemplated, or in jejunal ulcers or jejunocolic fistulas, when one wants to do a resection, the transverse mesocolon is already well scarred. When one frees the stomach and the site of anastomosis, one is almost compelled to do an antecolic anastomosis. It is here more important than any other place that one make a rather short jejunal loop. A long jejunal loop is likely to become adherent to the site of the old scar. If a short loop is made at the optimum site and is

brought well to the left, one is not so likely to get it into the region of the adherent omentum or into the old scar. A better functioning gastrojejunostomy is usually secured.

DR. JAMES T. PRIESTLEY, Rochester, Minn.: I am sorry that I cannot answer either of the questions that were asked.

Dr. Best asked about the operative mortality in cases in which jejunal ulcers followed the posterior type of anastomosis as compared with mortality following the anterior type. I can determine that from the series and shall send Dr. Best that information.

Of course, in a discussion about anterior or posterior type of anastomosis, I believe that one cannot help reemphasizing the point that probably the important thing in the end result that the patient obtains is really the amount of stomach removed, rather than the type of anastomosis performed.

I have not performed vagotomy in the treatment of gastrojejunocolic fistula.

PROLAPSE OF THE RECTUM

Report of a Case

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THIS paper is concerned primarily with the presentation of an unusual case of rectal prolapse. Although this subject has been adequately discussed by members of the Western Surgical Association and ample reference to it is found in the literature, it does not seem amiss to make some remarks concerning the causative factors relative to the development of rectal herniation and to comment briefly on the procedures employed to correct this condition. A rectal prolapse, or procidentia of the rectum, may be classified as mucosal or complete.

The mucosal type is an evulsion of the mucous membrance of the rectum and does not involve a descensus of the entire rectum. The mucous membrane that protrudes is smooth and represents simple evagination. It is commoner in older person with relaxed sphincters, who have had long-standing hemorrhoids.

True prolapse of the rectum, or herniation of the rectum, is a descensus of the entire rectum. This results from a pouch of peritoneum in the cul-de-sac or rectovesical space pushing its way through a congenitally weak or an acquired weak area of the pelvic fascia. The rectal sphincters are not primarily a factor. The hernia is on the anterior wall of the rectum and thereby pushes the apex of the herniated rectum posteriorly and lengthens and makes more convex the anterior surface. It is a progressive sliding hernia of the anterior wall of the rectum, perineal in character. The posterior rectal wall is not primarily involved.

There may be some difficulty early in distinguishing between a mucosal prolapse and a true prolapse. In the first instance the protruding mucosa is smooth, while in the latter it is wrinkled in a transverse relation to the long axis of the prolapse. Hayden[1] stated that

Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 5, 1947.

1. Hayden, D. P.: Prolapse of the Rectum, S. Clin. North America **27**:1062-1070, 1947. Pemberton, J. de J., and Stalker, L. K.: Surgical Treatment of Complete Rectal Prolapse, Ann. Surg. **109**:799-808, 1939.

any prolapse that is 2 inches (about 5 cm.) long and 2 inches wide and has wrinkling of the protruding mucous membrance in this characteristic fashion is a true procidentia of the entire rectum. It is commoner in women and may be associated with childbirth or pelvic surgical treatment which has resulted in pelvic fascia damage.

Moschowitz,[2] in 1912, first described this condition and presented a procedure for surgical correction. Many surgical attempts at repair have been presented since his original report, none of which has been eminently satisfactory. Perhaps, because, the condition being comparatively rare, few surgeons see many cases and no one has had the opportunity to follow a group of patients operated on by any one method or to perfect any standard form of surgical technic.

The problem can be approached from within the abdomen or externally. The essential principle of the procedures within the abdomen are directed toward obliteration of the cul-de-sac or rectovesical space by multiple purse-string sutures of nonabsorbable material, together with a suspension or fixation of the uterus in women. This is the principle of the Moschowitz operation, to which later was added, by others, the suturing of the sigmoid to the lateral pelvic wall. Mikulicz employed his type of colostomy of the sigmoid, with later division of the spur and closure of the colostomy without detaching it from the abdominal wall. This certainly should be a procedure that would at least take the slack out of the redundant sigmoid. It would not lessen the hernial opening through the pelvic fascia or rectal sphincter.

Mayo's[3] contribution is of value, as it obliterates the cul-de-sac or rectovesical space and forms a fascial floor above it, with strips taken from the fascia lata of the thigh. The external approaches are by the Lockhart-Mummery operation of packing gauze in the posterior rectal space or by amputation of the prolapsed mass, either by a necrosing ligature over a large rubber tube or by direct excision of the protruding bowel with closure of the hernial sac and suture of the bowel. Repair of the rectovaginal septum and perineum are essential in women.

De Lorme excised the exposed mucous membrane and reefed the muscular layer of the bowel, invaginating the muscle into the bowel until the mucous membrane was approximated and could be sutured. The packing of the posterior rectal space seems inadequate, as this

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2. Moschowitz, A. V.: The Pathogenesis, Anatomy, and Cure of Prolapse of the Rectum, Surg., Gynec. & Obst. **15**:7-21, 1912. Lorner, R.: Sur le traitement des prolapse de rectum totaux part l'excision de la muquese rectole an rectal-colique, Bull. et mem. Soc. d. chirugiens de Paris **26**:498-518,

3. Mayo, C. W.: Complete Rectal Prolapse: A Fascial Repair, Tr. West. S. A., 1937; West J. Surg. **46**:75-77, 1938.

portion of the rectum is only slightly prolapsed. The hernial defect is on the anterior wall and is not obliterated or excised by this method.

Graham's[4] operation of intra-abdominal repair of the levator muscles and pelvis fascia is a radical procedure, but attacks the problem as any other hernia is approached. The procedures of Pemberton and Mixter are somewhat similar and are dependent on adhesive fixation of the perirectal space after division of the peritoneum around the rectosigmoid, freeing the rectum and pulling the lower sigmoid taut and suspending it to the anterior abdominal wall.

COMMENT

The condition in the case herein presented did not lend itself to any of these procedures. It was too extensive, the hernial defect was too large and the surface in part covered by extensive leukoplakia, the true cell structure of which was questionable, so that any one of these procedures was inadvisable. Even if by biopsy it proved to be benign, it would be inadvisable to conserve this segment of the prolapsed bowel because of possible future developments.

A posterior rectal excision and a pull-down type of operation might have been successfully done. I, however, have not been enthusiastic about this procedure, probably because of lack of experience. Control of the bowel through this procedure, at least to me, seemed to be doubtful, and I, personally, would rather have an abdominal colostomy than a perineal one.

An abdominoperineal resection was therefore advised and accepted. This has given good results and has permitted the patient to return to a gainful occupation. The posterior operative site is well healed, and there is no hernia. The colostomy functions well and is of little trouble, certainly nothing in comparison with the patient's former difficulties. The colostomy is not on the side, as it is customarily placed, but is in the line of the operative incision, necessitated by a wide supporting band from his artifical leg, which passes over the left side of the abdomen. Photographs of the prolapsed rectum and of the excised specimen are presented. The roentgenographic evidence of a nonstrangulating type of obstruction of the small bowel, with resulting intestinal intubation and deflation with the Miller-Abbott tube, is shown. The colostomy and the posterior incision are shown to illustrate the position and character of the colostomy and the absence of perineal herniation.

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4. Graham, R. R.: The Operative Repair of Massive Rectal Prolapse, Ann. Surg. **115**:1007-1013, 1942.

REPORT OF A CASE

E. H., a white man, aged 49, was admitted to Research Hospital May 16, 1947, with prolapse of the rectum, and discharged June 5.

History of Illness.—In 1932 the patient first noticed some prolapse of the rectum when the bowels moved. At first, he stated, he thought that he had hemorrhoids, but the protruding mass rapidly became larger, until it finally reached the proportions presented at the time of examination. Prolapse occurred six to eight times a day for many years, and two years prior to examination the

Fig. 1.—The rectum in complete prolapse. The mass is 8 inches (about 20 cm.) in length and 18½ inches (about 47 cm.) in circumberence.

patient was unable to reduce the mass. After application of ice packs, the mass was reduced. Originally he had observed some bleeding, but had not noticed any for the past five to six years. The mass protruded with each evacuation and every time he strained, until the incidence was ten to fifteen times a day. Turning in bed often precipitated prolapse. The patient could replace the mass manually, but often with difficulty. The condition prevented his working. An area of cutaneous thickening, elevation and whiteness had occurred gradually in the last few years. The left leg had been amputated at the middle of the thigh in 1935, because of osteomyeolitis following an injury sustained in World War I. Nothing of significance was learned from the family and social history.

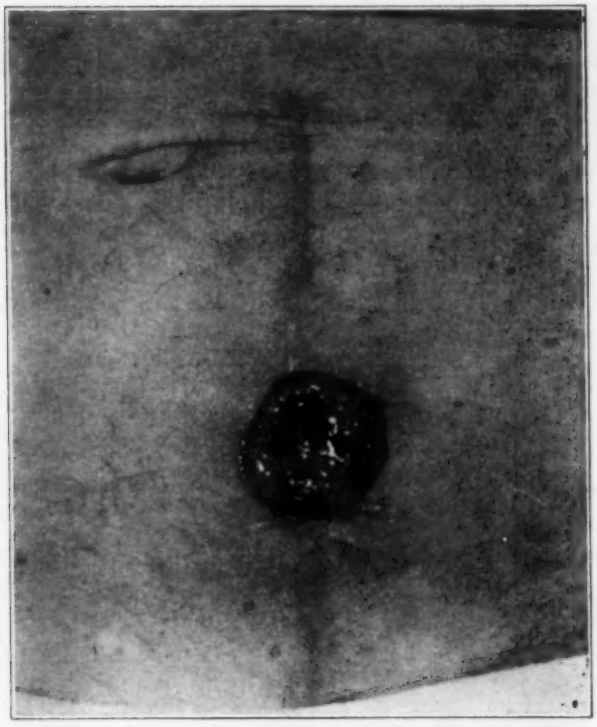

Fig. 2.—Colostomy in the line of operative incision.

Fig. 3.—The posterior incision is well healed. No herniation results on straining.

Physical Examination.—The patient appeared to be well. His heart and lungs were normal, and his blood pressure was 138 systolic and 90 diastolic. He had an incomplete easily reducible inguinal hernia on the right side. Rectal sphincter tone was absent, and the anus would almost admit the fist. On straining, the rectum prolapsed a great deal. A mass, measuring 8 inches (about 20 cm.) in length and 18½ inches (about 47 cm.) in circumference protruded. At the anterior mucocutaneous junction, extending onto the mucosa, was an area of leukoplakia about 2 inches (about 5 cm.) in width and several inches in length.

Fig. 4.—Roentgenogram showing a simple type of postoperative obstruction of the small bowel, with the transverse pattern of distention of the bowel and the valvulae conniventes visible, which is characteristic in simple obstruction of the small bowel.

Laboratory Observations.—Urinalysis revealed no abnormalities. The red blood cell count was 4,400,000, hemoglobin 86 per cent and white blood cell count 12,850. The Wassermann and Kahn reactions of the blood were negative. The level of sugar in the blood was 106 mg., nonprotein nitrogen 29 mg. and chlorides 435 mg. per hundred cubic centimeters.

Treatment.—Abdominal perineal resection, with colostomy at the upper portion of operative incision, was done on May 20. The only note of importance in the operation was that the pelvic peritoneum was thick and tough. It acted as good support in the closure of the sacral fossa. The postoperative recovery was complicated by distention of the bowel of the obstructive type. A roentgenogram

of the abdomen showed dilation of the small bowel, which assumed a transverse position to the long axis of the body and showed the valvulae conniventes. All of this indicated a simple obstruction and was not of the strangulated type. Intestinal intubation with the Miller-Abbott tube resulted in prompt deflation and uneventful recovery. The patient was seen many times after the operation and reported good results from the colostomy. He gained weight and was free from the annoying effects of repeated prolapse. Hernia did not occur at the site of rectal resection. At the time of writing, the patient was regularly employed.

Fig. 5.—Roentgenogram showing complete depression of the small bowel with the Miller-Abbott tube. The gas in the colon is seen here. This suggests the ileus type of obstruction.

Pathologic Data.—The specimen consisted of a resection of 25 cm. of tissue from the rectum and the sigmoid, with a triangular portion of perianal skin. There was dilatation of the lower portion of the specimen, with a circumference of the anal ring of 14 cm. The rectal pouch itself was dilated to a circumference of 18 cm. and could be made larger by filling with water. Beginning 13.5 cm. proximal to the internal anal sphincter, the bowel assumed a normal circumference of 5 cm. Just inside the internal anal ring there was a large area, measuring 6 cm. in diameter, in which there was a white reaction of the tissues, with piling up of tissue which had a rather irregular outline. No reaction was seen on the mucosal

surface of the bowel. Several large lymph nodes were present, but none suggested malignant growth.

Microscopic Examination: Microscopic examination showed normal mucosa, with ulceration in a few places. The surface was covered with exudate consisting mostly of polymorphonuclear cells. Section through the white area showed the presence of squamous epithelium, with no evidence of malignant development. There was no invasion of the wall of the bowel, and the lymph glands presented no malignant growth.

Diagnosis.—The diagnosis was rectal prolapse with areas of ulceration and squamous epithelium metaplasia.

COMMENT

I have found only 1 case in the literature, reported by Brashear,[5] in which the mass exceeded this one in length (18 inches "about 46

Fig. 6.—The removed specimen, showing the skin, mucosa and area of leukoplakia (18 cm. in width).

cm."); the width is of no consequence, the mass being cylindric and prolapse of only a few hours' duration. This was reduced by intra-abdominal traction and external manipulation followed by exteriorization of the devitalized sigmoid, after the method of Mikulicz.

ABSTRACT OF DISCUSSION

DR. THOMAS G. ORR, Kansas City, Kan.: It is probable that there are two factors which are active in the production of prolapse of the rectum, both of which may be congenital. One is lack of support of the rectum, due to relaxation or elongation of the rectosigmoid mesocolon, and the other is a deep cul-de-sac with

5. Brashear, R. I.: Massive Rectosigmoid Procedentia, Tr. Am. Proct. Soc. **43**:251-254, 1942.

some defect in the pelvic floor. It seems seasonable to believe that if these two defects could be repaired, first, by suspending the rectum and, second, by closing off the cul-de-sac, a cure would result.

I have some lantern slides which illustrate these points.

One slide shows the technic of cutting strips from the fascia lata for subsequent use in suspending the rectum (slide shown).

Fascial strips are placed, one on each side of the rectum, and sutured with a double row of silk sutures; at the upper end they are attached to the dense fascia over the sacral promontory. The rectum is pulled upward when these strips of fascia are placed. The left one must pass through the mesosigmoid at this point, (slide shown).

This slide shows the finished operation, in which the strips of fascia have been sutured to the deep fascia over the sacral promontory and covered with peritoneum. Here folds of peritoneum have been brought over to cover the entire suture line on each side of the rectum (slide shown).

The next step is to obliterate the cul-de-sac by as many rows of sutures as may be necessary. The peritoneum is sutured across the pelvis and to the anterior wall of the rectum. Here it is shadowed in the fascia strips and sutured to the rectum and to the dense fascia of the promontory (slide shown).

I feared that perhaps in some of these cases there might be a narrowing of the rectosigmoid junction, due to passing the strip of fascia through the sigmoid. Roentgenograms were made in 2 of these cases to see whether there was any evidence of obstruction.

In this instance the roentgenogram was taken about two months after the operation and again six months after the operation. There is no evidence of obstruction (slide shown).

Here is a similar slide of the colon. These slides were made before and after operation. There is no evidence of angulation or obstruction. Four patients have had this type of operation in the last four years. They have all apparently been cured.

I think that the principle of suspending the rectum with strips of fascia and obliterating the cul-de-sac really should effect a cure of complete prolapse of the rectum.

Dr. William Thompson, St. Louis: I have had experience with cases of this type at the St. Louis City Hospital, where one sees persons with varying degrees of prolapse of the rectum. I had never seen prolapse as severe as in the case presented by Dr. Hunt. I have seen protruded masses which may have been a little longer, but never of such diameter.

My most extensive experience with prolapse occurred before the days of chemotherapy, and 1 patient with pelvic sepsis died at operation (De Lorme). I have employed modifications of Pemberton's and Mixter's abdominal fixation and have combined the Moschwitz principle with this procedure, with reasonably good outcome. There was one recurrence with the Moschowitz type of procedure used alone.

I agree with Dr. Hunt in this particular case. I think that he used good judgment in the type of operation, and the result speaks for itself. I am sure, however, that he is not advocating abdominal perineal resection for prolapse. The reconstruction of the pelvic floor by the fascial strip method, as presented by Dr. C. W. Mayo several years ago, and its modification, as shown by Dr. Orr, are also useful.

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PIGMENT NEPHROPATHY IN BATTLE CASUALTIES

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AND

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THE DEVELOPMENT of progressive oliguria and anuria in battle casualties resuscitated from shock and apparently on the road to recovery following extensive surgical procedures, led to the death of a significant number of severely wounded soldiers. Death usually occurred between the fourth and eighth days after the wound was incurred. At autopsy the kidneys were observed to be somewhat enlarged, and on microscopic examination pigment casts were seen in the distal convoluted and collecting tubules. The proximal tubules were dilated, and a varying degree of necrosis of the distal tubules was observed, with some inflammatory reaction in the adjacent stroma. The capillary tufts in the glomeruli showed no changes, but there was in some cases slight swelling of the cells in Bowman's capsule. This lesion has been variously termed pigment nephropathy, hemoglobinuric nephrosis and lower nephron nephrosis.

Between Jan. 1, 1944 and the end of May, 1945, 1,631 soldiers died in Fifth Army Field and Excavation Hospitals. Reports on 86.5 per cent of these deaths from battle casualty were available for study.[1] In these 1,411 deaths, lower nephron nephrosis or pigment nephropathy led to death in 68 cases and contributed to death in 31 others. It was suspected to have been present in 57 additional cases. Autopsy was performed in all but 9 of the 99 cases in which pigment nephropathy was known to be present, and microscopic study of renal sections was reported in 67 of the 90 cases in which autopsy was performed.

A study of the 99 cases in which pigment nephropathy was known to be present forms the basis of this presentation. Of significance are

Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 5, 1947.

1. Snyder, H. E., and Culbertson, J. W.: Study of Fifth Army Hospital Battle Casualty Deaths: A Preliminary Report to the Surgeon, Fifth Army, September 1945.

the severity and multiplicity of wounds encountered in this group. Table 2 shows the type of principal wounds in 99 cases. It is seen that the abdominal cavity was involved in 59 cases. In table 3 one sees that intra-abdominal wounds were present as associated wounds in 2 more cases and suspected in 3 others. In only 20 cases were no wounds

TABLE 1.—*Pigment Nephropathy in 1,411 Hospital Battle Casualty Deaths*

Result or Status of Pigment Nephropathy	No. of Cases	Percentage of Cases
Led to death	68	4.8
Contributed to death	31	2.2
Suspected	57	4
Total	156	11

TABLE 2.—*Site of Principal Wound in 99 Cases of Pigment Nephropathy*

Site of Wound	No. of Cases
Intra-abdominal area	45
Combined intra-abdominal and intrathoracic area	6
Thoracoabdominal area	8
Intrathoracic area	4
Intracranial area	8
Intraspinal area	2
Lower extremity	18
Upper extremity	1
Cervical area	2
Uiclassified, multiple areas	5
Total	99

TABLE 3.—*Wounds Listed as Associated Wounds in 99 Cases of Pigment Nephropathy*

Site of Wound	No. of Cases
Intracranial area	5
Maxillofacial area (bones and soft tissue)	3
Eye or orbit	3
Maxillofacial area (soft tissue only)	9
Neck	9
Intraspinal area	7
Thoracic wall	6
Intrathoracic area	10
Suspected intrathoracic area	2
Abdominal wall (exclusive of intra-abdominal cases)	7
Combined intra-abdominal and intrathoracic area	1
Intra-abdominal area	1
Suspected intra-abdominal area	3
Upper extremity (includes 2 traumatic amputations)	44
Lower extremity (includes 2 traumatic amputations)	49

TABLE 4.—*Immediate Cause of Death in 31 Cases in Which Pigment Nephropathy Contributed to Death*

Immediate Cause of Death	No. of Cases
Fat embolism	3
Thrombotic pulmonary embolism	3
Clostridial myositis (gas gangrene)	4
Intracranial hemorrhage, trauma	3
Peritonitis	1
Pneumonia	2
Shock	5
Spinal cord trauma	1
Undetermined intra-abdominal lesion	2
Unclassified, undetermined	7
Total	31

present other than the one or ones listed as principal wounds. The one hundred and fifty-nine associated wounds listed in table 3 occurred in 79 cases, for a total of two hundred and thirty-eight wounds. (Multiple wounds confined to one region of the body, such as the

TABLE 5.—*Contributory or Associated Conditions in the 99 Cases of Pigment Nephropathy**

Contributory or Associated Condition	No. of Cases
Intracranial	
Intracranial abscess	1
Intracranial blast trauma	1
Encephalomalacia	6
Intracranial hemorrhage or hematoma	7
Cerebral ischemia	2
Meningitis	1
Cerebral trauma unclassified	6
Maxillofacial trauma	14
Cervical	
Cervical hemorrhage	3
Cervical trauma	8
Intraspinal	
Hematomyelia	4
Spinal cord hemorrhage	1
Transection of spinal cord	2
Partial transection of spinal cord	1
Spinal cord trauma	8
Extremities	
Crushing trauma of extremity	3
Frostbite or immersion syndrome	1
Extremity hemorrhage	15
Sepsis in extremity	8
Extremity trauma	66
Abdominal	
Abdominopelvic trauma	14
Extraperitoneal abscess	2
Intraperitoneal abscess	6
Adrenal hemorrhage	3
Adynamia ileus, severe	5
Adynamia ileus, mild or moderate	7
Abdominal blast trauma	2
Abdominal blast trauma, suspected	3
Cellulitis, mural and extraperitoneal	3
Peritoneal contamination from hollow viscera	39
Crushing trauma of abdomen	1
Crushing trauma of abdomen, suspected	1
Evisceration, postoperative	1
Evisceration, preoperative	
Gangrene of bowel	1
Gastric dilatation	6
Abdominal hemorrhage, primary	50
Abdominal hemorrhage, recurrent or delayed	2
Hepatic degeneration, toxic	16
Hepatitus epidemic	4
Hepatitis epidemic, suspected	1
Inflammation of gastrointestinal tract	2
Intestinal obstruction, severe	1
Intestinal obstruction, mild or moderate	1
Leaking suture line	1
Nephropathy evident, unclassified	31
Operative wound infection	3
Pancreatic hemorrhage	1
Pancreatic trauma	1
Pertionitis, severe	7
Peritonitis, mild or moderate	18
Peritonitis, suspected	2
Renal repair, parenchymal	2
Renal trauma	18
Renal trauma, suspected	2
Splenic degeneration, toxic	4
Splenomegaly	6
Unrepaired wound of hollow viscus	1
Ureter traumatized or tied	3
Urinary tract repairs	1

TABLE 5.—*Contributory or Associated Conditions in 99 Cases of Pigment Nephropathy—Continued*

Thoracic	
Pulmonary atelectasis, severe	1
Pulmonary atelectasis, mild or moderate	13
Pulmonary blast trauma	9
Pulmonary blast trauma, suspected	6
Bronchial fistula	1
Cardiac trauma	1
Cardiac trauma, suspected	1
Continuing intrapleural hemorrhage	1
Crushing trauma of chest	1
Dilatation of heart, severe	9
Dilatation of heart, slight or moderate	11
Empyema, mild or moderate	1
Empyema, suspected	1
Hemopneumothorax	27
Hemothorax without pneumothorax	3
Hydrothorax, severe	1
Hydrothorax, slight or moderate	23
Intrapulmonary hemorrhage, severe	7
Intrapulmonary hemorrhage, mild or moderate	21
Mediastinal edema	3
Mediastinal hemorrhage	3
Myocardial decompensation	27
Myocardial decompensation, suspected	27
Pneumonia, severe	4
Pneumonia, mild or moderate	19
Pneumonia, suspected	3
Pneumonitis	3
Pulmonary edema, severe	45
Pulmonary edema, slight, moderate	12
Purulent bronchitis	3
Tension pneumothorax	3
Tracheobronchial obstruction with blood and mucus	1
Thoracic trauma	13
Pleural contamination from hollow viscera in abdomen	1
General	
Gas gangrene of extremity	2
Gas gangrene of extremity, suspected	3
Gas gangrene of head, neck or trunk	1
Pulmonary fat embolism	8
Pulmonary fat embolism, suspected	4
Thrombosis, renal artery	3
Pulmonary thrombotic embolism	5
Pulmonary thrombotic embolism, suspected	1
Infarction of kidney	1
Infarction of lung	1
Thrombosis intracranial vessel	1
Thrombosis extremity artery	2
Thrombosis extremity veins	1
Anemia, refractory or severe	8
Jaundice	10
Malnutrition, severe	1
Transfusion reaction, severe	3

*These are in addition to the condition listed as the immediate cause of death.

lower extremity or the intra-abdominal area, were listed as only one wound. The same is true of the 20 cases in which no associated wounds are listed, as in many of these cases there were multiple shell fragment or bullet wounds confined to one region of the body.

In all of the deaths in battle casualties studied, attempt was made to ascertain an immediate cause of death. Lower nephron nephrosis was regarded as the immediate cause of death in 68 cases. In 31 cases some other cause was thought to be the immediate cause of death. Table 4 shows the diagnosis in the 31 cases. The so-called immediate cause of death, however, fails to give a complete picture of the multi-

plicity of pathologic conditions existing in this group. Table 5 shows the contributory or associated conditions existing in the 99 cases of pigment nephropathy. Pulmonary complications were so frequent as to be almost the rule. In many cases the giving of intravenous fluids in the absence of urinary excretion led to high volume of the blood, cardiac failure and pulmonary edema. Toxic hepatic degeneration was present in 16 cases, epidemic hepatitis in 4 cases (suspected in 1 more) and septic hepatitis secondary to trauma in 2 cases (suspected in 3 more). There was recorded evidence of renal trauma in 18 of the 99 cases, and a ureter had been traumatized or tied in 3 other cases. Fat embolism was the immediate cause of death in 3 cases, contributing cause of death in 8 cases and was suspected as contributory to death in 4 more cases. The 11 cases in 99 represent an incidence of

TABLE 6.—*Lowest Recorded Systolic Blood Pressure and Other Shock Data in 99 Cases of Pigment Nephropathy*

Data	Recording	No. of Cases
Systolic blood pressure	0	22
Systolic blood pressure	2-38	1
Systolic blood pressure	40-58	9
Systolic blood pressure	60-78	13
Systolic blood pressure	80-88	6
Systolic blood pressure	90-98	5
Presence of shock stated, no other data		13
Treatment suggests shock, no other data		25
No evidence of shock		5
Total		99

TABLE 7.—*Units (250 cc. each) of Plasma Administered in 99 Cases of Pigment Nephropathy Before Admission to a Hospital Installation*

Units	No. of Cases
None or no record	29
1	16
2	19
3	22
4	10
5	3
6	1
8	1
11	1

11 per cent, which is considerably higher than in the whole series of 1,411 battle casualty deaths, in which 49 cases constitutes only 3.5 per cent. It is also interesting to note that in the 49 patients known to have pulmonary fat embolism, 11 had pigment nephropathy. Severe reactions from blood transfusion were noted in only 3 of the 99 cases. Gross infection was evident in 61 cases.

One outstanding feature in the cases in which anuria developed was the severity of the shock which occurred some time between wounding and the development of renal insufficiency. In the 99 cases in which pigment nephropathy was known to exist, the lowest recorded blood pressures are shown in table 6, along with other data relative to shock. The 5 cases the records of which gave no evidence of shock

are of sufficient interest to warrant presentation of case summaries (cases 3, 4, 5, 6 and 7).

It must be remembered that many of the records were rather incomplete. Data regarding the duration of low blood pressure were available in only a few instances. No data concerning the level of blood pressure prior to admission to a hospital are available. The amount of plasma administered before admission is perhaps the best index of shock at that time. In table 7 the number of units of 250 cc. of plasma administered before admission is recorded. Table 8 shows

TABLE 8.—*Cause of Shock in 94 Cases of Pigment Nephropathy*

Cause	No. of Cases
Trauma and hemorrhage alone	41
Trauma and hemorrhage plus cardiorespiratory embarrassment	17
Trauma and hemorrhage plus contamination or sepsis	25
Trauma and hemorrhage plus cardiorespiratory embarrassment and contamination or sepsis	17

TABLE 9.—*Units of Plasma Administered in 99 Cases of Pigment Nephropathy*

	No. of Cases			
No. of Units	Before Admission	After Admission Before Operation	During Operation	After Operation
No record	29	60	75	68
1	16	12	9	7
2	19	16	8	7
3	22	4	2	5
4	10	2	2	5
5	3	2	1	0
6	1	2	2	4
7	0	0	0	2
8	1	0	0	1
9	0	0	0	0
10	1	0	0	0
11	1	1	0	0

TABLE 10.—*Amount of Blood Administered in 99 Cases of Pigment Nephropathy*

	No. of Cases		
Pints of Blood Administered	Before Operation	During Operation	After Operation
No record	33	45	49
1	10	14	23
2	10	14	8
3	13	6	5
5	14	6	8
5	11	2	4
6	3	5	1
7	2	2	1
8	1	2	0
9	2	2	0
10	0	0	0
11	0	1	0

the cause of shock in the 94 cases of pigment nephropathy. No effort was made to separate trauma and hemorrhage as causative factors in shock. Cardiorespiratory embarrassment was felt to be a definite factor. Contamination of the peritoneum or pleura with feces or severe infection, particularly of the pleura, peritoneum, or of an extremity, certainly contributed to shock. The amounts of plasma and blood used after admission to the hospital are further indexes of the degree of shock in these patients. Recorded data available concerning this are

included in table 9 and table 10. Blood transfusion as a causative factor will be discussed later.

Treatment with oxygen might be expected in a larger percentage of patients than is shown in table 11. Only 13 patients received oxygen before operation and only 27 after operation.

TABLE 11.—*Oxygen Therapy in 99 Cases of Pigment Nephropathy*

	No Record	Before Operation	During Operation	After Operation
No. of Cases	36	13	47	27

TABLE 12.—*Operating Time for Primary Operation in 99 Cases of Pigment Nephropathy*

Operating Time (Min.)	No. of Cases
No operation	11
Less than 30	0
30-60	0
60-90	1
90-120	3
120-150	2
150-180	3
180-210	7
210-240	2
240-300	4
300-360	2
More than 360	2
Not stated	62

TABLE 13.—*Anesthesia in 68 Patients Who Died of Pigment Nephropathy*

	No. of Patients	
Anesthesia	Primary Operation	Secondary Operation
Ether, closed system	31	2
Ether, open drop	3	0
Ether, unclassified	15	2
Endotracheal*	28	1
Nitrous oxide*	28	2
Pentothal sodium*	3	2
No record	14	3
Death occurred before induction of anesthesia†	4	3

*All were known to have had ether except 1 patient for whom the record stated "endotracheal anesthesia."
†All had crush injuries.

TABLE 14.—*Anesthesia in 31 Cases in Which Pigment Nephropathy Contributed to Death*

	No. of Cases	
Anesthesia	Primary Operation	Secondary Operation
Ether, closed system	13	1
Ether, Flagg method	1	4
Ether, open drop	1	0
Ether, unclassified	5	0
Endotracheal	7	0
Nitrous oxide induction	11	1
Local	1	1
"Pentothal sodium"*	0	0
No record or none	3	2
Patient died before anesthesia was complete	7	

*Sodium 5-ethyl 25-(1-methylbutyl) thiobarbiturate.

The operating time (table 12) for primary surgical treatment is a further index of the severity of the wounds in this group of cases. Unfortunately, the time was not stated in 62 of the cases; no operation was performed in 11 cases. In the remaining 26 cases, however, it is seen that in only 1 case did the operation last less than an hour and a

half, while in the largest group of cases the operating time was from three to three and one-half hours. Data concerning anesthesia in the 68 patients who died of pigment nephropathy are presented in table 13. It will be noted that with exception of 4 patients who died before anesthesia was complete, all of whom had crush injuries, all had been given ether. In table 14 the anesthesia in 31 cases in which pigment nephropathy was a contributing cause of death is recorded. Of this group, 7 patients died before anesthesia was complete; 1 had local anesthesia only, and all of the rest had ether anesthesia in one form or another. The patient who had local anesthesia only had an intracranial wound and died of pneumonia, septic hepatitis and jaundice.

TABLE 15.—*Analysis of Cases in Which Death Occurred Before Anesthesia and in Which Pigment Nephropathy Contributed to Death*•

No. of Cases	Wounds	Immediate Cause of Death	Shock	Time Lap. Wounding to Death (Hr.)	Urinary Output
1	Intracranial Abdominal wall	Pulmonary embolism (thrombotic)	Uncorrected; lowest blood pressure recorded 60/20	Not recorded	Record inadequate
1	Intraspinal Neck Intrathoracic (bilateral) Upper extremity	Undetermined	Corrected; adm. blood pressure 50/0	14	No record
1	Intracranial (bilateral) Multiple wounds	Shock	Uncorrected	33	No record
1	Intraspinal Intracranial Maxillofacial Neck and upper extremity	Spinal cord trauma	Shock correction doubtful	113	No record
1	Traumatic amputation, lower extremity	Fat embolism	Shock correction doubtful	25	No record
1	Multiple, extremities and face	Gas gangrene	Uncorrected	76	Record inadequate
1	Intracranial Both lower extremities and one upper extremity	Gas gangrene	Uncorrected	73	

•Diagnosis of pigment nephropathy in each instance was based on microscopic study of renal sections.

There was a record of adequate urinary output and no evidence of shock. On the basis of microscopic autopsy alone, the diagnosis of pigment nephropathy was made. Data for 7 patients who died before the induction of anesthesia in this group are presented briefly in table 15. The diagnosis of pigment nephropathy in each of these cases is based on microscopic study of renal sections. All the patients had severe wounds; most of them died a comparatively short time after being wounded and correction of shock was doubtful or shock was completely uncorrected in all but 1 patient. Data concerning the amount of urine passed were unavailable. Ether was considered to be the anesthetic of choice in all battle casualties with shock or severe

wounds. Hence, no significance can be attached to the high incidence of ether anesthesia in this group of patients with pigment nephropathy.

When the first cases of anuria were encountered, the sulfonamide drugs were regarded as the probable causative factor. Sulfanilamide powder was dusted into almost every wound on the battlefield, and most of the wounded soldiers had taken 4 Gm. by mouth before reaching the hospital. Early in the period under study it was common practice to administer 5 Gm. of a sulfonamide drug intravenously to all with abdominal wounds immediately on admission to the hospital and to repeat this dose at intervals of twelve to twenty-four hours thereafter. With the appearance of anuria, this practice was discontinued, and no sulfonamide drug was given intravenously until twelve hours after operation and only after the patient had fully reacted from shock. At the same time the amount of sulfanilamide dusted into the peritoneal cavity was limited to 5 Gm. and the amount in all wounds to 10 Gm. That sulfonamide drugs were a causative factor at least in 1 case, cannot be refuted. That they were not the only factor except in a few cases, likewise, was evident from subsequent studies. There were 30 of the 68 cases in which death from pigment nephropathy occurred and 14 of the 31 cases in which pigment nephropathy contributed to death in which there was no record of sulfonamide therapy, excluding the sulfanilamide powder dusted into wounds at the time of the first aid dressing.

The microscopic observation of a lesion termed hemoglobinuric nephropathy focused attention on blood transfusion as a causative factor. Prior to the establishment of a blood bank unit in the Mediterranean theater, reactions from mismatched and unmatched transfusions did occur in a few instances. However, anuria continued to develop after the use of group 0 blood from the blood bank. Then it was thought that the transfusion of a large quantity of group 0 blood to group A or group B recipients might be responsible for anuria in some of the cases; however, low titer group 0 blood (containing anti-A and anti-B iso agglutinins in a titer of less than 1 to 120) was used for all except group 0 recipients, and it was later ascertained[2] that the incidence of pigment nephropathy in the persons of the four blood groups paralleled the relative incidence for persons of the four groups in the general population. In a previous article[3] a case of Major James M. Mason was mentioned in which a group A recipient received 5,500 cc. of low titer group 0 blood before and dur-

2. Mallory, T. B.: Hemobloginuric Nephrosis in Traumatic Shock, Am. J. Clin. Path. **17**:427-443 (June) 1947.

3. Snyder, H. E., and Culbertson, J. W.: Causes of Death in Battle Casualties Reaching Hospitals, Am. J. Surg. **73**:184-198 (Feb.) 1947.

ing operation for a thoracoabdominal wound, which involved the removal of one kidney. There was no evidence of insufficiency in the remaining kidney, and the patient made an uneventful recovery. It was likewise demonstrated[4] that the shock occurring in battle casualties was due in most instances to loss of whole blood and that the apparently massive doses of blood used in resuscitation of these patients were excessive in only a few instances. In most cases determinations of the volume of blood established the fact that not enough whole blood was being used in the resuscitation of these patients. It was also observed that many patients showing gross hemoglobinuria did not always experience renal insufficiency, while, on the other hand, in many of the fatal cases of pigment nephropathy hemoglobinuria was never apparent grossly.

Early in 1944, at the same time that a reduction in the use of sulfonamide drugs was effected, the use of sodium bicarbonate to render the urine alkaline was encouraged. In many cases it was given by mouth as soon as treatment with sulfonamide drugs was started; in others it was given intravenously prior to sulfonamide medication and blood transfusion. Records regarding this treatment were seldom complete, but in the 99 cases of nephropathy the use of sodium bicarbonate was reported in 21 cases.

The hepatorenal syndrome was considered as a mechanism which might account for anuria in some of the cases. The reports of Orr, Helwig, and Schutz[5] constituted the chief source of information for American surgeons concerning renal shut-down associated with trauma. It was apparent, however, that the majority of patients seen did not present evidence of hepatic damage, although such was present in no inconsiderable percentage. Review of the microscopic renal observations in the cases reported by Orr and Helwig would lead one to believe that the condition they described was pigment nephropathy.

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4. (*a*) Lalich, J. J.: Transfusion Therapy in the Battle Casualty Exhibiting Evidence of Circulatory Failure: Report to the Commanding Officer, Second Auxiliary Surgical Group, June 1944; Hematocrit and Plasma Protein Findings in Battle Casualties Treated in a Field Hospital, Report to Surgeon Mediterranean Theater of Operations, United States Army, November 1944. (*b*) Lalich, J. J., and Mason, J. M., III: Resuscitation of Severely Wounded Battle Casualties, Surgery **18**:741-753 (Dec.) 1945. (*c*) Stewart, J. D., and Warner, F.: Observations on the Severely Wounded in Forward Field Hospitals with Special Reference to Wound Shock, Ann. Surg. **122**:129-146 (Aug.) 1945. (*d*) Simeone, F. A.: Personal communication to the author based on work of Commission for the Study of the Seriously Wounded.

5. Orr, T. G., and Helwig, F. D.: Liver Trauma and the Hepatorenal Syndrome, Ann. Surg. **110**:682-692 (Oct.) 1939. Helwig, F. D., and Schutz, C. B.: A Liver Kidney Syndrome, Surg., Gynec. & Obst. **55**:570-580 (Nov.) 1932.

Lucké[6] has reviewed 538 cases in which the disease was fatal, the records and material of which were received at the Army Institute of Pathology during the war. He found the characteristic renal lesion in eleven groups, which included cases in which there were battle wounds, crushing injuries, abdominal operations, burns, reactions from blood transfusion, intoxication due to sulfonamide drugs, heat prostration, malaria due to infection with Plasmodium falciparum (black water fever), poisoning due to a variety of agents, hemolytic edema and such unrelated conditions as uteroplacental damage, acute pancreatitis and rickettsial disease.

With increasing experience with the condition, it became the opinion of many that the severe degree of shock occurring in most of the cases must be responsible at least in part for the development of nephrosis. In the fall of 1944, a commission for the study of the seriously wounded was appointed by Colonel Edward D. Churchill, Theater Consultant in Surgery. The work of the commission (H. K. Beecher, C. H. Barnett, T. B. Mallory, S. Shapiro, F. A. Simeone and E. A. Sullivan) has not yet appeared in print, but all observations of practical value were made available immediately in the forward hospitals. This commission made elaborate studies, both clinical and laboratory, on battle casualties in severe shock when admitted to forward hospital installations. Prior to this time, clinical observation by many and laboratory investigation by Stewart,[4c] Lalich[4a,b] and others had led to the general belief that shock in persons suffering injury in battle was in most cases due to loss of whole blood. The studies of the commission confirmed this opinion and defined the exceptions to the rule. It was learned that in the cases in which nephropathy developed the observation of a benzidine-reacting pigment in the specimens of urine was a constant feature. Study of this pigment by a chemical method showed that it was myoglobin in cases of crush injury, but that in the other cases it might be hemoglobin or myoglobin or a combination thereof. Except in the cases in which there were crush injuries it was impossible to predict from the nature of the injury what type of pigment would be seen in the urine. Mallory, a member of the commission, observed that it was not possible by microscopic study of the kidneys to determine whether a lesion had been produced by poisoning due to sulfonamide drugs, mismatched transfused blood or other factors. Mallory pointed out that the deposit of pigment in the distal convoluted and collecting tubules does not seem to be the first pathologic change in the kidneys. In 11 of their patients who died of injury within seventy-two hours, only 2 showed pigment casts in significant numbers.

6. Lucké, B.: Lower Nephron Nephrosis. Mil. Surgeon **99**:371-396 (Nov.) 1946.

Prior to the appearance of pigment casts, a fine fat vacuolization of ascending limbs of Henle's loops appears. Mallory stated that this appears in 75 or 80 per cent of patients who experienced shock, regardless of whether clinical evidence of renal insufficiency develops or not, and that the process is reversible. He expressed the belief that the pigment casts play no role in the initiation of renal insufficiency following shock but that one cannot state that they have no effect in the later stages of the disease. The dilatation of the renal tubules proximal to the casts and about them would lead to the assumption that they do produce a degree of obstruction, at least in the involved tubules.

Reports of clinical observations and experimental work appearing in recent literature begin to throw a little more light on this problem. Cournand[7] and his associates, in a carefully made study of 6 patients in a state of shock, observed that the measurement of renal clearances showed decided reduction in effective renal flow of blood out of proportion to the decrease in the systemic flow of blood with a filtration fraction either normal or low.

Corcoran and Page,[8] in an experimental study of the crush syndrome in rats and dogs, reached the conclusion that the underlying mechanism in post-traumatic anuria is vasoconstrictive renal ischemia, that this ischemia results in oliguria, which, associated with aciduria, predisposes to the precipitation of pigment casts, and that tubular injury due to ischemia and a hypothetic toxic agent may contribute to the renal damage. The same auhors, in collaboration with Gibson, Aub, and Evans,[9] showed that normal rats will tolerate the transfusion of inadequately refrigerated stored blood better than rats with one crushed limb. They also showed that transfusion of sterile refrigerated blood which has been preserved for only one or two weeks decreases the amount of renal injury which occurs in experimental crush syndrome in rats.

Lalich,[10] who had wide experience in the resuscitation and study of battle casualties in a state of shock and with post-traumatic anuria, stated that he had the impression at that time that dehydration might be a factor in the production of nephropathy. Many of the patients

7. Cournand, A.; Riley, R. L.; Bradley, S. E.; Breed, E. S.; Noble, R. P.; Lauson, H. D.; Gregersen, M. I., and Richards, D. W.: Studies of the Circulation in Clinical Shock, Surgery **13**:964-995 (June) 1943.

8. (*a*) Corcoran, A. C., and Page, I. H.: Genesis of Crush Syndrome, J. Lab. Clin. Med. **30**:351-352 (April) 1945; (*b*) Crush Syndrome: Post-Traumatic Anuria, J. A. M. A. **134**:436-441 (May 31) 1947.

9. Gibbson, Aub, and Evans, cited by Corcoran and Page.[8]

10. Lalich, J. J.: The Influence of the Injections of Homologous Hemoglobin on the Kidneys of Normal and Dehydrated Animals, J. Exper. Med. **86**:153-158 (Aug.) 1947.

had been without water to drink for many hours prior to their admission to a hospital. Since the war, Lalich has performed experimental work on rabbits and rats and has shown that injections of homologous hemoglobin in normal animals rarely produce significant renal damage; however, when hemoglobin is injected into the dehydrated animal, hemoglobinuric nephrosis can be consistently reproduced. He stated that it remains to be determined whether dehydration exerts a direct influence on the precipitation of pigment casts or acts indirectly through altered physiologic responses. Recent work on the role of ischemia in the production of nephropathy would tend to support the latter view.

In attempts to reproduce the human lesion in dogs, Phillips, Van Slyke and others[11] have undertaken a series of experiments in which one kidney was removed and the renal artery on the other side was clamped for varying periods of time. Uremia was produced, but Mallory[2] observed that the anatomic lesion consisted in diffuse degenerative changes, ranging to complete necrosis of the proximal tubules, but insignificant changes in the lower nephron and no formation of pigment casts.

Trueta[12] and his associates investigated the possibility that the mechanism of vasoconstrictive renal ischemia is a reflex one. They stated that in the course of their research they have secured evidence that vascular short circuiting can occur in the kidney and that the blood supply to the cortex in particular can be reduced by short circuiting to any degree up to complete ischemia. According to their reports, this can be accomplished by stimulation of renal vasomotor nerves. Such a pattern of ischemia might well lead to the lesions of the lower nephron seen in persons with pigment nephropathy. Trueta has maintained in the past that the application of plaster casts to the limbs of patients with crush injury tended to prevent renal damage. He theorized that the plaster casts were effective in that they diminished painful stimuli leading to reflex vascoconstriction in the kidney.

REPORT OF CASES

Case 1.—An infantryman suffered a perforating wound of the left lower part of the abdomen and the left hip from a machine gun bullet. He was admitted to the battalion aid station ten and a half hours later. Six and a half hours more elapsed before his admission to a field hospital. At this time the blood pressure was

11. Phillips, Van Slyke and others, cited by Mallory.[2]

12. (*a*) Trueta, J.:. Renal Anoxia, Lancet **2**:415 (Sept. 29) 1945. (*b*) Barclay, A. E.; Daniel, P.; Franklin, K. J.; Prichard, M. M. L., and Trueta, J.: Records and Findings Obtained During Studies of the Renal Circulation in the Rabbit with Special Reference to Vascular Short-Circuiting and Functional Cortical Ischemia, J. Physiol. **105**:278-288 (Sept. 18) 1946.

unmeasurable. He was given 500 cc. of plasma and 2,500 cc. of low titer group 0 blood prior to operation. A catheterized specimen of urine appeared blood stained. A laparotomy was performed seven hours after admission and twenty-four hours after the wound had been incurred, and a laceration of the jejunum and early severe peritonitis were observed. The laceration was sutured; the peritoneum was irrigated with isotonic solution of sodium chloride and 100,000 units of penicillin, and 10 Gm. of sulfanilamide were deposited in the peritoneal cavity. The wound at the left hip, which had produced a compound fracture of the greater trochanter, was debrided. He was then given 5 Gm. of sodium sulfadiazine intravenously. Treatment with penicillin, 25,000 units every three hours, was started on admission. The blood pressure at the end of operation was unmeasurable, but within two hours rose to 100 systolic and 80 diastolic. His postoperative course was characterized by progressive oliguria, edema, uremia, disorientation and respiratory distress. Death occurred on the eight postoprative day. On the first postoperative day he received 500 cc. of blood, 500 cc. of plasma, 1,000 cc. of dextrose in isotonic solution of sodium chloride and 5 Gm. of sulfadiazine. On the second postoperative day he was given 500 cc. of blood, 2 units of plasma, 2,000 cc. of dextrose in isotonic solution of sodium chloride and 5 Gm. of sulfadiazine. No more sulfadiazine was given and no more blood except 1 pint (about 473 cc.) the day prior to death. Two days prior to death the nonprotein nitrogen in the blood was 91 mg., chlorides 605 mg. and sulfadiazine 13.23 mg. per hundred cubic centimeters. His urinary output on the day of operation was 150 cc., and on successive days it was 200 cc., 350 cc., 300 cc., 600 cc., 400 cc., undetermined and 75 cc.

At autopsy, the peritoneal cavity contained a small amount of thick grayish yellow foul-smelling pus and the viscera were plastered to one another and to the parietes by a coating of exudate up to 4 mm. in thickness. The liver was approximately 50 per cent heavier than normal, and the capsule was tense beneath the sheet of exudate on its surface. On sectioning, the cut surface was nutmeg brown, with well defined architectural units. The spleen was doubled in size, and the capsule beneath the exudate was grayish red. The kidneys were moderately enlarged; the capsules stripped readily, revealing surfaces which were darker brown than normal, with fine dark red points and lines scattered throughout. The cortices were slightly widened; the pyramids were swollen and discolored by brown and red lines paralleling the tubules. The apexes of the pyramids were dark brownish yellow. The lungs did not collapse normally, and their weight was decidedly increased, particularly on the right side. Cut surfaces were moist and released blood-stained mucoid fluid on pressure. There were slightly firm purplish red areas scattered throughout all the lobes, but these were confluent only in the lower parts of the right upper and right lower lobes. Examination of the renal sections showed that the glomeruli were moderately congested; the tubules were slightly dilated. The distal convoluted and collecting tubules contained numerous brown granular and hyaline casts. Many tubules contained desquamated epithelial cells and polymorphonuclear cells. One tubule showed a decided proliferative reaction interspersed with polymorphonuclear cells. Here the inflammatory process extended into the interstitium. There were scattered crystals of a sulfonamide drug within the lumens of the distal tubules. The interstitial tissues contained engorged blood vessels, and there was extravasation of small red cells. Microscopic pathologic diagnoses included: pigment nephrosis, hemorrhagic bronchopneumonia, acute purulent perihepatitis and perisplenitis.

Case 2.—A 21 year old soldier was injured during a bombing raid when a stone building collapsed on him. He was extricated from beneath a pile of stone

after three and two-thirds hours and reached an evacuation hospital fifteen minutes thereafter. There was no visible evidence of traumatism, and skeletal roentgenograms revealed nothing of significance. His blood pressure was 104 systolic and 74 diastolic, and the pulse rate was 120. The urine was wine colored, with no red cells. Approximately seven hours after admission he was given 500 cc. of type 0 blood and then 1,000 cc. of 5 per cent dextrose. Four or five hours later he went into a state of shock. This was evident by pallor, loss of radial pulse and no blood pressure. A transfusion was started, but when the hematocrit was observed to be 70 per cent it was discontinued, after 300 cc. were given, and dextrose with isotonic solution of sodium chloride substituted. The blood pressure rose to 100 systolic and 80 diastolic. A specimen of urine was chocolate colored. He complained of many points of muscular soreness and tenderness, and the areas were tense and brawny on palpation.

During the succeeding nine days he remained oliguric, the daily output of urine ranging from 50 to 100 cc., with an intake of about 3,000 cc. of fluid. Sodium bicarbonate was given daily in 2.5 per cent of solution. The patchy muscular induration increased. The urine became normal in color on the third day, but still had a positive benzidine reaction. On the sixth day, the face was puffy and there was pitting edema over the sacrum. The blood pressure was 150 systolic and 110 diastolic. Magnesium sulfate was given intramuscularly. During the next three days, the edema increased and the hypertension persisted; epistaxis became frequent, and death occurred with relative suddenness a little less than ten days after the injury. The level of nonprotein nitrogen in the blood reached a total of 291 mg. and creatinine 12.2 mg. per hundred cubic centimeters the day before death occurred. A check for myoglobin on one specimen of urine early showed a concentration of 588 mg. per hundred cubic centimeters. At autopsy, all muscles appeared paler than normal and scattered throughout the skeletal musculature were many focal areas of traumatic damage. In most instances these were segments of muscles closely proximate to bone. Larger foci noted were in the flexor group of the left forearm, the left vastus medialis, the lower quarter of the right sartorius and all of the right soleus. The general pattern was a pigmented grayish white area in the muscles surrounded by a hemorrhagic border. Some of these areas appeared translucent and like fish flesh; others were frankly necrotic, with an opaque slightly grayish infiltration. Some foci appeared almost chalky, and the muscle fibers in the involved areas were friable and easily torn. The kidneys weighed 550 Gm. They were symmetrically enlarged, and the vessels of the perirenal fat were engorged. One focus of hemorrhage in this fat was noted at the lower pole of the right kidney. It was entirely extracapsular. The capsules stripped readily and left pale smooth surfaces. The arteries and veins were patent. On sectioning, the cortex was pale and swollen. The surfaces appeared moist; the pyramids were dark, with a hint of brown in predominant redness. The vessels were not engorged, and no gray zone was present at the corticomedullary junction. The report of the microscopic study was not available in this case, but it may be said that essentially the same picture was seen in patients with crush injury as in those with pigment nephropathy resulting from transfusion, poisoning due to sulfonamide drugs and wounds attended with severe shock.

Case 3.—A soldier was wounded in action near Cassino, Italy, by artillery shell burst. He was admitted to an evacuation hospital approximately four and a half hours later, in good condition and showing no signs of significant loss of blood. In the shock tent he was given 60 grains (3.9 Gm.) of sulfadiazine and 500 cc. of plasma. Thirty minutes later, in the operating tent, the wound of entrance overlying the head of the left femur posteriorly was debrided, and the

tract followed up toward the anterior-superior iliac aspect of the spine, where a counter incision was made. A foreign body was removed without difficulty, along with two or three comminuted bone fragments. A penetrating wound of the left forearm was then debrided and the foreign body removed. Both wounds were treated with sulfanilamide powder and petrolatum gauze. During the operation with the patient under gas, oxygen and ether anesthesia, a blood transfusion was started. Later, while the patient was still on the operating table and still under anesthesia, generalized shaking chill, or rigor, began. The transfusion was discontinued and 500 cc. of plasma given. The same blood was matched again and observed to be compatible, and the rest of it was administered without untoward reaction. Following the operative procedure a catheter was inserted, and 120 cc. of dark blood-stained urine was obtained. From this time on, a catheter was employed every twelve hours. The bladder was still empty after twenty-four hours. His general condition remained essentially unchanged until approximately eight hours prior to death, when he became irrational, breathing became irregular and increasing pulmonary edema developed. He died approximately seventy-two hours following operation.

He had received no blood other than that previously noted. In addition to the aforementioned amount of sulfadiazine, he was given 8 Gm. by mouth the first twenty-four hours, but none thereafter. Post mortem, the gross examination of the kidneys, ureters and the bladder failed to reveal any abnormality; however, microscopic examination of the kidneys revealed nephrosis of the lower nephron.

Case 4.—A crush syndrome developed in a soldier, similar to the one presented in case 3, except that there was no history of low blood pressure at any time during the four and one-half days that he lived after injury.

Case 5.—A soldier suffered a perforating wound of the brain, a penetrating wound of the left jaw and a perforating wound of the right shoulder. He was admitted to an evacuation hospital over ten hours after the wound had been incurred. On admission his blood pressure was 130 systolic and 74 diastolic, the pulse rate 78 and respiration 20. A roentgenogram of the skull showed that a foreign body 1.6 cm. in size had perforated the skull in the left parietal region, had passed through the parietal lobes and had perforated the right frontal aspect of the skull, to come to rest with the bone fragment before it under the scalp. A linear fracture, 12 cm. long, extended backward in the frontal bone on the left, from the depressed fracture entrance. The patient was comatose on admission. He exhibited palsy of the right seventh nerve and spasticiy in all extremities. Débridement of the wound of the skull and the brain was performed about six hours after the patient's admission to the hospital. In addition, the wounds of the jaw and the shoulder were debrided. He was given 1,500 cc. of blood and 1,000 cc. of plasma during the operation. He remained comatose until his death. He had a relatively high temperature, with increased pulse rate and respiration. He received sodium sulfadiazine intravenously in a dosage calculated to produce a level in the blood of 20 mg. per hundred cubic centimeters. Oliguria developed about five days postoperatively, which progressed to complete anuria in two more days. Cystoscopy was performed, and the renal pelves were lavaged with sodium bicarbonate solution. Numerous sulfadiazine crystals were observed, particularly in the left renal pelvis. He died seven days after he was wounded. Microscopic observations at autopsy included indications of encephalomalacia, bronchopneumonia and pigment nephrosis.

Case 6.—A soldier was wounded in action by a high explosive shell fragment one or two days before admission to an evacuation hospital. The exact date and the time of his wounding on Mount Porchia, Italy, were unknown. On admission

he was semistuporous and showed changes in his reflexes, and the roentgenogram showed depressed fracture of the right parietal bone, with a large bone defect and fragments of bone and metallic foreign bodies driven into the right cerebral hemisphere. The operative risk was considered poor, and he was given 500 cc. of plasma before operation, 500 cc. of blood during operation and 500 cc. of blood shortly thereafter. Operation was performed under block anesthesia with procaine hydrochloride approximately eight hours after his admission to the hospital. Partial craniectomy, with thorough débridement of the wound of the brain and dural repair, was accomplished. At termination of the operation the patient was sent to the ward in satisfactory condition, with a blood pressure of 120 systolic and 70 diastolic, a pulse rate of 120 and a temperature of 100.2 F. Postoperatively he received 10 Gm. of sodium sulfadiazine intravenously, in two doses of 5 Gm. each in the first twenty-four hours and 5 Gm. intravenously in divided doses in the second twenty-four hours. Subsequently, he received sulfadiazine, 6 Gm. daily by mouth, through the eighth postoperative day. He also received 1 unit of concentrated plasma twice daily for eight days and four blood transfusions postoperatively. He was never entirely rational or lucid, but at times he responded moderately well to questions and talked coherently. Four days postoperatively the patient had a crisis, characterized by clonic contractions of the right side of the body and face for a few seconds, followed by twitching for several minutes and a sudden rise of temperature to 107 F; the pulse rate was 160 and respirations 52. All subsided quickly. His daily temperature, aside from this one episode, was from 102 F. to 103 F. On the ninth postoperative day the patient was much weaker and drowsier and responded poorly to questions. He showed hemiplegia and facial paralysis of the left side, which had been present all along, plus weakness of several cranial nerves. Treatment with sulfadiazine was discontinued on this date, and his condition was considered critical. The next day he was much worse, presenting dyspnea, cyanosis, tachycardia, decided pulmonary congestion, jaundice and coma. A diagnosis of terminal bronchopneumonia was made; the cause of the jaundice was not clear. At postmortem examination, it was noted that the common duct and larger branches were not obstructed and that the gallbladder was not enlarged. On sectioning the hepatic tissue appeared to be deeply jaundiced and the appearance was somewhat suggestive of a diffuse necrotic process. The parenchyma of both kidneys appeared to be within normal limits; the kidneys were about normal size, and the capsules stripped normally. The pelves of the kidneys were stained with bile, and the mucosa contained numerous pinpoint hemorrhages. No crystals were evident. There were no signs of infection in the wound of the brain. The diagnoses, based on gross pathologic studies, were: nonobstructive jaundice, the cause of which was undetermined, bronchopneumonia and hepatitis. The report of microscopic examination of the section of the liver was not available, but the following diagnoses, based on microscopic studies, were made: (1) bronchopneumonia, (2) jaundice and (3) slight hemoglobinuric nephropathy. The significance of the latter diagnosis is not entirely clear. This patient was carefully studied, and his daily urinary output was over 1,000 cc. except on the day of his death. It is perhaps incorrect to assume that hemoglobinuric nephropathy contributed to death in this case.

Case 7.—A soldier was admitted to a field hospital approximately one day after being wounded by enemy shell fire near Montecatini, Italy. He suffered compound fractures of the left tibia and fibula in the middle third, a compound fracture of the left clavicle, a compound fracture of the left scapula and multiple penetrating wounds of the left buttock. All of his wounds were debrided under open drop ether anesthesia in the field hospital. Six days later he was evacuated

to an evacuation hospital, where he died one hour and twenty minutes after admission. There was nothing further in his record concerning his clinical course. Postmortem examination was done, and it was observed that both kidneys were enlarged, that the cortex was pale and swollen and irregular in both kidneys and that the capsule stripped easily. A diagnosis, based on gross pathologic studies, of nephrosis was made, the cause of which was unknown. There were no microscopic observations in this case. Also presented were bilateral pleural effusion, a hematoma in the upper lobe of the left lung and pulmonary congestion and edema, as well as the wounds previously noted. While there was no evidence of shock recorded, it probably should be stated that the record was too inadequate to permit the conclusion that shock did not exist at one time or another.

CONCLUSIONS

The condition described as pigment nephropathy, or lower nephron nephrosis, occurs with a variety of conditions. In battle casualties, the renal damage is probably dependent on renal ischemia plus the excretion of pigment. The renal ischemia is vasoconstrictive in origin and occurs in patients in a state of shock and with related conditions. Whether or not the vasoconstriction is induced by a toxin elaborated from damaged tissues or by reflex vasomotor stimulation has not been definitely established. The pigment excreted may be myoglobin or hemoglobin. The source of the hemoglobin may be from transfused blood, intravascular hemolysis, and probably from other sources. The role of infection has not been clearly defined and should be made the subject of investigation. The influence of the various anesthetic agents should be studied.

Treatment should be prophylactic. Shock should be combated vigorously, with prompt restoration of the volume of blood to normal. This should be accomplished with the proper medium, which for most battle casualties is whole blood. Treatment with oxygen is of value in combating anoxia, which must result from vasoconstriction in the renal circulation. Injudicious use of sulfonamide drugs should be avoided, and discontinuance of their use in conditions predisposing to nephropathy should be considered. Dehydration should be avoided when possible and otherwise corrected as promptly as possible. Thorough surgical removal of all devitalized tissue and foreign bodies and provision of adequate drainage to infected areas is important.

SUMMARY

Ninety-nine cases of pigment nephropathy or lower nephron nephrosis in battle casualties are presented. In all but 5 cases there was evidence that shock had existed in some degree over a varying period of time. Of the 5 cases in which evidence of shock was not presented, poisoning due to sulfonamide drugs, crush injury and transfusion reaction were present in 4. In the fifth case the record was so

inadequate as to prevent the drawing of any conclusions. The severity of the wounds, the number of complications, the amounts of blood and plasma used and other possible causative factors are discussed. Reference is made to recent experimental work by numerous investigators. Conclusions relative to causative factors and their bearing on the treatment for the condition are presented.

DISCUSSION

DR. IRVING WILLS, Santa Barbara, Calif.: I think that the authors have presented admirably the important features of a serious problem. While the series of cases was limited to battle casualties, there is a lesion which general surgeons and urologists see from time to time and must be prepared to treat.

In addition to the causative factors presented, there is a condition which sometimes occurs in the patient subjected to transurethral prostatic resection. It was pointed out recently by Creevy of Minneapolis, and it is somewhat surprising that during about fifteen years of resection operations, no one apparently had recognized the condition, although several writers have described postoperative oliguria and Foley of St. Paul actually observed jets of pigmented urine coming from the ureteral orifices during the course of a transurethral resection.

A stream of water flows into the bladder during the entire resection operation, and, if, as often happens, venous sinuses are opened in or about the prostatic capsule, the water may flow directly into the blood stream, with consequent hemolysis of the blood. The hemoglobin thus produced is toxic to the kidney, and the changes which occur include vacuolation necrosis and desquamation of epithelium of Henle's loops and the distal convoluted tubules and pigmented casts in these and in the collecting tubules—in short, lower nephron nephrosis. If they are not too extensive, the changes are reversible, and, as shown by Flink, repair may begin about five days after the onset.

Nesbit and his associates at Ann Arbor, Mich., recognize two stages of the disease, relative to treatment. In the first it is important not to give the patients too much fluid. They appear to be in a state of shock, may show a hemoconcentration and seem to be dehydrated, but the fluid is in the tissues and addition of isotonic solution of sodium chloride or dextrose solution will almost invariably produce pulmonary complications, particularly edema of the lungs. The presence of a high level of nonprotein nitrogen should be no great cause for alarm. These patients do not have uremia. One of my patients had a level of nonprotein nitrogen of 250 mg. per hundred cubic centimeters, but remained conscious and lucid. Fluid in the form of dextrose without isotonic solution of sodium chloride should be supplied only in sufficient quantity to make up for the insensible loss.

If the patient survives this initial period, the kidney will usually begin functioning by the fourth or fifth day, and the quantity of fluid excreted may rapidly rise to tremendous amounts. This excreted fluid is not urine, but a glomerular filtrate, since the tubules have not yet begun to function and there is little or no resorption of fluid or electrolytes. During this state, Nesbit pointed out, it is imperative that the treatment be directed toward replacement of both the fluid and loss of electrolytes. Failure to do so may result in the development of hypochloremia. Blood chlorides should be tested at two hour intervals to determine the replacement needs.

It seems to me that one should look for this condition in patients who have been involved in automobile accidents when there is massive crushing of tissues,

in patients undergoing prolonged surgical procedures with extensive handling of viscera, in patients receiving multiple transfusions and in patients undergoing cesarean section, with extravasation of blood into the uterine muscle, as well as in patients undergoing the aforementioned urologic procedure. Incidentally, pigment nephropathy may be prevented in patients undergoing transurethral resection by the use of dextrose solution as the irrigating medium, as suggested by Creevy, or an isotonic solution of aminoacetic acid, now in use by Nesbit.

Until a more satisfactory method of treatment is available, the points outlined should aid somewhat in handling this difficult and serious problem.

DR. WILLIAM KENNETH LIVINGSTON, Portland, Ore.: The speaker mentioned the work of Trueta. Last summer (1947) I saw some of his work in Oxford, England. I hesitate to speak about it, because I am not familiar enough with all its details, nor am I certain how this work bears on the work mentioned by Dr. Wills, based on the study of hemolysis.

The work was started because so many persons sustained crushed limbs when buried by debris during the London air raids. These persons seemed to be in good condition until the limb had been freed, and then rapidly oliguria or anuria developed and the patient died.

The investigators started by compressing, with a tourniquet, a rabbit's leg for four and one-half hours. About ninety minutes after the tourniquet had been removed it was possible to demonstrate by arteriography that there was profound spasm present, not only in the leg that had been constricted but in the other leg and in the aorta. It appeared to the investigators that the spasm involved the renal arteries but perhaps spared the mesentery arteries. Then they began to inject dye into normal rabbits to determine the exact length of time after the injection of the dye into the jugular vein that was necessary for obtaining the best arteriogram of the kidney and, subsequently, how many more seconds must elapse before the best venogram could be obtained. The "intrarenal time," that is, the interval of time between the best arteriogram and the best venogram, was approximately three seconds; that is, this was the intrarenal time for the normal rabbit. In the rabbit with the crushed limb, the intrarenal time was cut in half; that is, about a second and a half. The arteriogram would show also that the blood was already appearing on the venous side. The investigators reviewed the anatomy of the kidney and observed that it had long been known that the glomeruli close to the medulla differed in size and in construction from those of the cortex, the cortical glomeruli being smaller, with an efferent artery that broke up promptly into capillaries; whereas, the larger glomeruli near the medulla seemed to have a larger efferent artery that could not be demonstrated as breaking up into capillaries.

Then by a microtechnic they injected some kidneys (using plastics I believe) and were able to show, by injecting the venous side with dark dye and the larger glomeruli with light substances, that there was a direct intermingling of these dyes within the veins. The communication was by way of the efferent arteries which lead directly from the larger glomeruli into the veins in the medulla of the kidney. This shunt apparently came into play not only after the application of the tourniquet but after strong stimulation of the splanchnic nerves or stimulation of the sciatic nerve.

In other words, Trueta's group demonstrated a reflex mechanism, apparently set up by a massive sensory stimulus which caused spasm of the renal vessels associated with profound ischemia of the entire cortex, and the shunting of arterial blood directly into the medullary veins.

The corollary of this work was that if the splanchnic nerves were removed before the tourniquet was applied or the sciatic nerve was stimulated, the kidneys were not involved in the shunt mechanism, whereas, the arteries of the legs presented the same degree of spasm. The suggestion is that in patients threatened with oliguria, and perhaps anuria and death, a successful bilateral block of the splanchnic nerves might abolish the renal shunt and restore normal equilibrium. Patients who undergo transurethral resection, if they can be brought through the critical phase, apparently regain normal function, and, a few months after the crisis has passed, all tests of renal function seem to show that the renal excretion and functional reserve return to a normal level.

DR. HOWARD E. SNYDER, Winfield, Kan.: Dr. Livingston has given a fine review of the work that Trueta is doing.

The point brought out by Dr. Wills, that one encounters shock in cases other than those of battle casualties, is certainly a good one. I think that one must remember that shock is an important factor, whatever the mechanism in the production of this syndrome, and that the replacement of the whole blood as it is lost at operation, avoiding surgical procedures which produce painful stimuli and the like, will help to maintain a lower incidence of this fatal complication.

EVOLUTION IN THE TREATMENT OF INGUINAL HERNIA

With Some Considerations for Successful Repair

A. E. BENJAMIN, M.D.

AND

H. G. BENJAMIN, M.D.

MINNEAPOLIS

INGUINAL hernia is one of the unsolved problems of surgery. This disability has troubled persons of every climate, race and color from time immemorial. For many centuries it has engaged the attention of men of science and art, as well as charlatans; a Phoenician statuette showing a double inguinal hernia has been unearthed. It has been estimated that hernias of all varieties occur in from one-sixteenth to one-eighth of the population.

A hernia was not usually meddled with until the subject began to suffer greatly or was incapacitated because of the size of the hernia, incarceration or strangulation. Then the services of the medical man, priest or sorcerer was sought. Since hernia was considered to be a visitation of the gods by some, incantation or prayer was practiced. The physicians of the day, being ignorant of the cause of the malady and knowing little about the anatomic structures and imperfections of the tissue, did little.

One of the first trusses was employed by Celsus. It consisted of a strap and a plate. In 1305, Gordon suggested a spring truss. This was not adopted universally until 1785. The French Academy approved of irritants up until about a hundred years ago. Infection often resulted; sloughing occurred, and many lives were lost. Potassium hydroxide, silver nitrate and acacia were injected into the inner surface of the sac.

There seems to have been little progress made in the treatment of inguinal hernia from 400 B.C. to the eighteenth century. Even as late as the middle of the eighteenth century, Potts of England and others were attempting to cure hernia with cautery. Some surgeons expressed the belief that it was necessary to open the sac and cauterize the ring.

Read at the meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 4, 1947.

At the beginning of the nineteenth century, many crude attempts were made to cure the hernia by inducing local sepsis or hardening in the sac. The injection method for the cure of hernia was revived about twenty-five years ago and was used rather extensively until a few years ago. It cured the small indirect hernia occasionally, and some present day surgeons used it frequently, until experience caused them to abandon the procedure.

Sir Astley Cooper was one of the foremost surgeons of his time and a good anatomist. He studied the various tissues that supported the intra-abdominal organs and called attention to what he termed "the ligament of the pubis," later known as Cooper's ligament. No doubt, he is responsible for the progress from that time on, and the careful clinical study of cases with the intent to bring about permanent cure in these cases.

Dr. John Wood, recognizing the principles which govern the causes and cures of this defect in nature, sutured or approximated the pillars of the rings with pins, as in operations for harelip, and S. D. Gross, in 1861, performed a similar operation with success. Dr. Wood, after having operated on 200 patients, reported 50 per cent of cures in adults and 75 per cent in patients operated on before they attained puberty.

Dr. H. O. Marcy was probably the first surgeon to put into practice a method of operating on patients with hernia that resembled the modern method. During his day, the suture material that was used was not to be depended on. He used kangaroo tendon and sewed up the defect in the inguinal region. About the same time, Bassini demonstrated his method of operating. From that time on, nearly all surgeons came to the conclusion that the hernial region must be opened up, the tissues all identified, the sac separated from the cord and the surrounding tissues and ligated high up at the internal ring and the stump returned to the abdomen. Also some form of approximation of the muscles and fascia to Poupart's or Cooper's ligaments must be made, so that the posterior wall of the canal is restored and will withstand the intra-abdominal pressure.

The first operation performed under antiseptic methods was performed by Lister, in 1869, for an inguinal hernia. Thereafter, the operation for hernia, as well as for all other conditions, became less hazardous; fewer infections occurred, and success was more assured.

There is considerable controversy at the present time over suture material. For what conditions should surgical gut, linen, silk, wire, tendons or fascial strips be used? There are many articles written today by surgeons attempting to prove the efficacy and advantages of a special kind of suture material.

Garner[1] stated, "A study of 2,040 patients in the U. S. Veterans Administration Hospital in Dayton, Ohio, indicates there has been a trend recently toward the use of fascial sutures and fascial grafts in hernia repair."

Ramos and Burton[2] said, "Silk is the ideal suture in the repair of hernia.s" L. M. Zimmerman[3] stated, "Even the use of autogenous fascial sutures has failed to live up to the high hopes originally entertained."

Because of the lack of universal confidence in any one kind of suture material to be left in the tissues, we decided to use some boilable suture material that could be used as stay sutures and removed when they had served their purpose.

There are various types of operations that have been advocated for hernia: the Macewen, McBurney, Bassini, McArthur, Gallie, Halsted, Andrews and other types. There have been many modifications of the Bassini operation. Each technic may have its special advantages in certain cases.

There are sixty or more methods of operating on inguinal hernia recorded in the literature. There is great variation in types of inguinal hernia and methods must be varied accordingly.

However, there seems to be some confusion and uncertainty among operators. In discussing the anatomic structure and repair of inguinal hernia, McVay and his co-workers,[4] who have used Cooper's ligament repair, have done much to clarify the anatomic confusion that has existed among operators.

Bartlett[5] expressed the belief, "Bassini's operation will not be abandoned until evidence is produced that aternative methods have regularly yielded lower percentages of failure."

We have performed an operation in a number of cases, the details of which are as follows: A Ferguson incision is made down to the external oblique fascia. All bleeding vessels are ligated with fine plain surgical gut. The wound is protected with towels clipped to the skin. The external oblique fascia is split over the cord from the external to the internal ring. The hernial sac is dissected from the sur-

1. Garner, A. D.: Inguinal Hernia: An Analysis of 2,643 Operations, Am. J. Surg. **126**:23 (July) 1947.

2. Ramos, R. L., and Burton, C. C.: The Results of the Treatment of Biocular and Direct Inguinal Hernias, Surg., Gynec. & Obst. **70**:953 (May) 1940.

3. Zimmerman, L. M.: Newer Contributions to the Surgery of Inguinal Hernia, Wisconsin M. J. **45**:397 (April) 1946.

4. McVay, C. B.; Anson, B. J., and Morgan, E. H.: The Anatomy of the Region of Inguinal Hernia, Quart. Bull. Northwestern Univ. M. School **16**:221, 1942.

5. Bartlett, W., Jr.: Observations on a Concept of Inguinal Hernia Repair, Surg., Gynec. & Obst. **83**:60 (July) 1946.

rounding tissue to and within the internal ring and there ligated with plain surgical gut. The outer portion of the sac is removed and the stump fixed back of the transversalis above the internal ring. In cases of direct inguinal hernia we either remove the excess of any sac or separate the peritoneum from the nearby overlying structures and imbricate the peritoneum. Interrupted mattress sutures of silk or "dermalon" (a nylon suture) are then passed through the transversalis, internal oblique fascia inner leaf of the external oblique fascia and conjoined tendon. Then the two ends pass through the shelving edge of Poupart's, or occasionally Cooper's, ligament and, finally, through the fat layer and skin to the outer side of the wound (fig. 1).

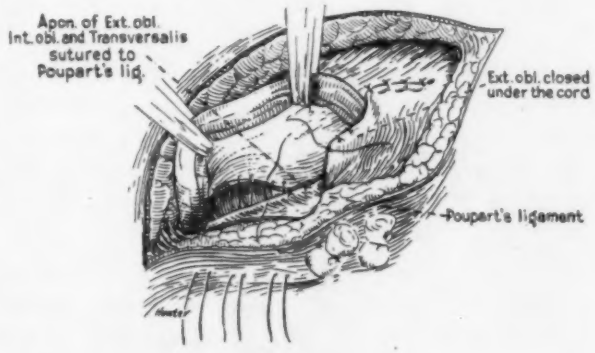

Fig. 1.—Drawing of a stage of the operation described.

These sutures, three to five in number, according to the size and nature of the hernia, are simultaneously pulled taut, bringing the muscles, fascia and Poupart's ligament in close approximation, where they are anchored with a few fine interrupted sutures of chromic surgical gut. The contiguous structures around the internal ring are imbricated around the upper portion of the cord with similar fine sutures after removing all intervening fat tags.

The external oblique fascia is then imbricated, stitching the outer leaf to the inner leaf, below the cord, with sutures of fine chromic surgical gut. The mattress sutures are then tied over rolls of gauze, which gives them some elasticity and prevents the sutures from cutting through the tissues. The fat layer is closed with fine plain surgical gut and the skin with "dermalon." This operation is similar to a Halsted operation except that the removable mattress sutures are depended on for support, making fewer interrupted sutures necessary.

In some thin persons we did not include the external oblique fascia in the mattress retention sutures, but imbricated it above the cord with interrupted sutures of fine surgical gut. Figure of eight retention

sutures also anchored the imbricated aponeurosis of the external oblique fascia and simultaneously closed the fat layer and skin, and these sutures were then tied over a roll of gauze (fig 2).

In this operation it was observed that hemostasis and a closer union of tissues was accomplished. Each muscle and fascial layer complemented its neighbor and promoted healing; the nerve and blood supply was disturbed little. We have had only 1 case of mild infection. We found it possible, by using these retention mattress sutures, to get the patients up early. The sutures were usually removed at the end of the second or third week. Several years ago one

Fig. 2.—The sutures approximating the muscles and Ponpart's ligament are shown tied over single rolls of gauze. The figure of 8 sutures, made to close the fascia and skin, are tied over the long roll of gauze.

of us (A.E.B.) published "An Operation for Hernia Followed by the Ambulatory Treatment."[6]

Some of the causes of recurrence of inguinal hernia may be listed as follows:

1. There may be a lack of surgical cleanliness.
2. Hemostasis may be incomplete.
3. The operator may not be familiar with all anatomic irregularities present and may choose the improper method.
4. A coexisting femoral or indirect hernia may not be observed.
5. The operation may be hastily or carelessly done, without consideration of all the facts present.
6. Rough handling may injure muscles, tendons, nerves and blood supply.
7. The sac may not be thoroughly separated at the internal ring.

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6. Benjamin, A. E.: An Operation for Hernia Followed by Ambulatory Treatment, J. Minnesota M. A. **28**:290, 1908.

8. Fat tags may be left, which separate structures intended for union and support.

9. Fascia and muscle may be improperly anchored.

10. Weak sutures may break from intra-abdominal pressure and prevent healing of the structures.

11. The suture material may be too heavy and cause irritation and poor union.

12. Sutures, when tied too tightly, may strangle the tissue and cause degeneration of muscle or fascial fibers.

13. Large knots on sutures may cause exudation and hinder close union.

14. The use of large tendonous suture material separates the fibers and weakens the structures.

15. The build and posture of the patient, such as overweight or insufficiently developed muscle tissue, may be a contributing factor.

16. Postoperative exercises to maintain vitality and strengthen tissues are instituted.

It has been estimated that there is about 7 to 12 per cent of recurrence of direct hernia and 5 to 8 per cent of indirect hernia. In 1901, Ricketts[7] gave the average recurrence in over 6,000 cases of thirty-four operators as 5.58 per cent. At that time the types employed consisted of Marcy's, Bassini's, Macewen's, Halsted's, Blake's, Ferguson's, Andrews', and Phelps' operations.

Statistics presented by Garner[1] showed a rate of recurrence of 3.4 per cent in cases in which Cooper's ligament repair was used, as compared with 7 to 10 per cent in Poupart's ligament repair for primary inguinal hernia.

Ramos and Burton[2] stated, "In 711 herniorrhaphies followed up, there have been so far, 67 recurrences, or 9.4 per cent of the total. Of the total of 67 recurrences, 49 of them, or 71.2 per cent appeared during the first three years."

In this paper, we are reporting two hundred and twenty-six operations for inguinal hernia performed on private patients by the special method already described. All other types of operations performed by us are excluded.

Operations by Retention Mattress Sutures

	No. of Cases
Male	213
Female	13
Right	149
Left	90
Indirect	182
Direct	43
Double	11
Incarcerated	2
Strangulated	7

We have follow-up records of one hundred and fifty-three of these operations, with recurrence in 6 patients, or 3.9 per cent.

7. Ricketts, B. M.: Inguinal Hernia, Am. Med., May 1901.

ANALYSIS OF RECURRENCE

A critical analysis of recurrence in the 6 patients is herewith given, and an effort is made to determine the cause of the recurrence.

Case 1.—The patient was a man aged 52, with a right direct inguinal hernia, for which he had undergone operation twenty years prior to examination. The condition returned as an omental hernia, with incarceration for several days with infection and exudation. Devitalized tissues and inability accurately to approximate the tissues were the probable causes for recurrence in two years.

Case 2.—The patient was a man aged 61, with a right direct inguinal hernia, which recurred as an incarcerated adherent omental hernia with exudate. The devitalized tissue and difficult closure were the probable causes of its return in eight years.

Case 3.—The patient was a man aged 57, who had a right direct omental hernia with many adhesions. The sac had been inadequately separated, and only two mattress sutures had been used, which were the probable causes of the return of a small mass in four months.

Case 4.—The patient was a man aged 57, with a right indirect inguinal hernia. Alcoholism, fat around the sac and the internal ring and the difficulty in dissection high enough were the probable causes for recurrence in fourteen years.

Case 5.—The patient was a man aged 79, with a right direct inguinal hernia. An emergency operation had been performed for strangulated bowel three months prior to examination; devitalized tissue at the time of the second operation was the probable cause of recurrence in six years.

Case 6.—The patient was a man aged 68, with a left direct inguinal hernia. A large adherent sac that may not have been thoroughly dissected and heavy work followed the operation, which may have been the causes for recurrence in twelve years.

SUMMARY AND CONCLUSIONS

Persons living in the early centuries and suffering from inguinal hernia received little benefit from treatment.

When the anatomic structure of the inguinal region was understood and antiseptics were employed, surgeons began to cure many persons.

The multiplicity of operations for inguinal hernia indicates that physicians disagree on the operative procedures.

The type of suture material and the tissues to be included in these sutures are still debatable matters.

Evaluation of present day operations should be made. Some surgical organization should study the problem thoroughly, in order that operations may be standardized and the percentage of recurrence lessened.

78 South Ninth Street (2).

DISCUSSION

DR. L. H. APPLEBY, Vancouver, British Columbia: The paper read by Dr. Benjamin emphasizes clearly a point which has been clear to me for years, that is, the fact that actually there is no particular problem inolved in simple indirect inguinal hernia. The problem, as I see it, is bound up in direct inguinal hernia.

The figures presented included 182 cases of indirect and 43 of direct inguinal hernia. There were 6 cases of recurrence, of which only 1 was of indirect inguinal hernia. The rate of recurrence was a fraction of 1 per cent. Surely one could ask for no better results than that.

But the remaining 5 cases of recurrence are of the group of 43, so that the actual rate of recurrence, while it is only 3.9 per cent, is actually 5 out of 43, or 11.6 per cent, in so far as it affects the group of cases in which there was direct inguinal hernia.

I think that the two groups may be compared. The simple indirect hernia, as a rule, is in the stout younger person, whereas, the direct hernia, for which recurrence was 11.6 per cent, occurs in the senior years, as a rule, and usually there are multiple afflictions, possibly prostatic, bronchitic or cardiac, and various other diseases that go with the hernias of advancing years, so that I think that there must be a certain optimum rate of recurrence in that second group, which is irreducible.

I worked with two series of cases in which there were direct inguinal hernias, one series prior to the war, 300 consecutive cases, with a rate recurrence of 8.6 per cent. About that time, 1942, the use of stainless steel wire was introduced, and I became an ardent advocate.

During the war I did rather a large number of operations for hernia in British Columbia. I did a second series of three hundred operations with stainless steel wire, with the advantage of modern anesthesia and all of the preoperative and postoperative preparations incident to modern surgical treatment, and the percentage of recurrence in my second series was 4.6 per cent. Therefore, I think that I have practically cut the rate in half, with modern surgical technics and stainless steel wire.

I think that this paper points out with clarity the distinction between these two types of cases, that is, there is little or no problem with indirect inguinal hernia in the young sthenic type of person. The problem is in recurrence in patients with direct inguinal hernia—the youngest patient in whom there was recurrence was actually 52 years of age.

DR. CASPER F. HEGNER, Denver: Dr. Benjamin has again called our attention to the inadequacies of operations, and more important, he has emphasized the reasons for failure, the commonest of these being the failure to restore the parts to as near their normal anatomic and physiologic status as possible and the failure to supplement any inherent weakness in the anatomic structures that may be present.

Not all recurrence takes place through the original inguinal ring. In chronic hernia, the long-standing indirect type, the sliding of the internal ring to underlie the external ring is an important factor. This makes for weakness in the structures. This is due not only to anatomic but also to physiologic processes.

The fact that many different operations have been devised to cure hernia is ample proof that there is no one satisfactory operation, nor is there any one suture material entirely satisfactory for meeting the variance that may lead to the reformation of hernia.

Much thought and ingenuity have been given to the restoration of anatomic factors. To my knowledge little has been written or spoken about physiologic mechanics of the muscles of the inguinal region. I have examined many relaxed

large inguinal rings and yet do not observe that hernia develops unless and until there is a lack of muscle coordination. In fact, the inguinal ring is caught off balance in the development of a hernia. Contrary to what has been said in previous discussion, that they only occur in old men, I have seen many in younger men. I am sure that the disturbed physiologic mechanics of the muscles of the part are as important as the weakened anatomic relations, not only in the development of the original hernia but also in the recurrence. I am equally sure that some operations interfere with or entirely destroy the sliding mechanisms of the contracting muscles as well as their sphincter action in controlling the ring.

DR. ARTHUR E. BENJAMIN: My plea in this paper particularly is that some organization take up this subject, correlate our efforts, and try to point out where the errors are. There are too many cases in which there is operation for hernia and not enough cases in which there is cure. I think that it is due to the fact that some operators are unacquainted with the structures that are really necessary for support.

I have tried to follow the technic of the various operators here and abroad. In visiting various clinics I have noted the inadequacy of some operations, following which I believed that there would be recurrence, especially in the cases in which there was direct inguinal hernia. Our problem is not so much with the indirect as with the direct inguinal hernia.

I adopted this method because I was not satisfied with the suture material. I was not certain that the sutures would hold long enough. The strong mattress sutures make a closer union between the opposing structures and, when tied over gauze rolls, obviate undue pressure, irritation and possible infection.

I am asking for a more general effort on the part of surgeons to study this question. I think that it would be wise if this organization would appoint a committee for that purpose, to permit standardization of work.

EVALUATION OF COLORECTECTOMY AND IMMEDIATE ANASTOMOSIS OF THE RECTUM

R. RUSSELL BEST, M.D.*
OMAHA

IN THE evolution of surgery for the extirpation of carcinoma of the rectum and rectosigmoid, there is now a tendency to revert to the original operations for this malady. In 1898, Cadol,[1] in France, published a historical review of the treatment of rectal cancer and reported that Lisfranc in 1826 was the first to extirpate a cancer of the lower part of the rectum. Colostomy was not used in conjunction with operations for removal of malignant lesions of the rectum until fifty years later. Lisfranc concluded that one should operate when the finger could go beyond the upper limits of the diseased area and the perirectal tissues were healthy, so that the rectum and tumor mass could be everted and the whole tumor with the anus excised, leaving a posterior rectal opening or fistula. Modifications of this technic were developed, but the rate of mortality was high, averaging 80 per cent. Recurrences were about 100 per cent, and enthusiasm waned for another fifty years. The Lisfranc method developed to the procedure of anal dilation, circular section of the rectum below the neoplasm, lowering of the tumor and rectum, section above the neoplastic ring and fixation of the upper end of the rectum to the skin of the anal margin. In 1873, Verneuil[2] adopted the earlier suggestion of Aurussat that the coccyx be removed to permit better exposure, and he also attempted sphincter preservation.

In 1885, at the Surgical Congress in Berlin, Kraske[3] reported two successful attempts in extirpating rectal carcinoma by partially resecting the sacrum to permit better exposure for total excision of diseased

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Read at the Fifty-Fifth Annual Meeting of the Western Surgical Association, Colorado Springs, Colo., Dec. 5, 1947.

1. Cadol, A.: Histologie pathologique et traitement du cancer du rectum, Arch. gén. de med. **1**:571, 1898.

2. Verneuil, A.: Traitement palliatif du cancer du rectum, Semaine méd. **12**:-146, 1873.

3. Kraske, P.: Zur Exstirpation hochsitzenden Mastdarmkrebse, Verhandl. d. deutsch. Gesellsch. f. Chir. **14**:464, 1885.

tissue and suturing the upper end of the rectum to the normal sphincter. He sutured only the anterior wall of the rectal anastomosis, leaving a sacral anus, which he closed at a later date. Kraske was obstinate in the early stages about adopting the method of suturing around the entire circumference, but he finally accepted it as the better procedure. Following Kraske's initiative, many new posterior incisions and methods of bone excision were introduced, and the American and French schools did not allow themselves to be outstripped in the international scramble for attaching the surgeon's name to each slight change in technic.

The establishment of a preliminary colostomy to sidetrack the fecal contents before excising a tumor posteriorly and reestablishing bowel continuity was probably first carried out by Adams in England in 1882 and Shede[4] in Germany in 1887.

To avoid some of the complications incident to breakdown of the anastomosis suture line in the procedure of posterior excision and anastomosis, Hochenegg[5] in 1888 presented his "pull through" operation. After extirpation of the diseased segment, the rectum was pulled out through the anus and sutured. This proved to be a popular method.

Modifications of the Lisfranc, Kraske and Hochenegg procedures with sphincter preservation, but not always good sphincter control, continued to be presented. The mortality rates improved, but continued to be too high. Complications were frequent and severe, and early recurrence was at a high figure. Statistics at the turn of the century revealed an average of 16 per cent three year cures.

In 1892, Maunsell presented his abdominoperineal (abdominoanal) method of mobilization and dissection of the rectum and sigmoid through an abdominal incision, reestablishment of the pelvic diaphragm and, after closure of the abdominal wound, carrying of an incision around the anus with preservation of the sphincter muscles. The sphincter ani and levator ani muscles were incised in the midline, the bowel was pulled down and out and excised and the end sutured to the sphincter and levator ani muscles. This is the type of procedure which Babcock[6] and Bacon[7] have advocated for several years. Modifications of the original procedure have been developed.

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4. Schede, M.: Zur Operation des Mastdarmkrebses, Deutsche med. Wchnschr. **8**:1048, 1887.

5. Hochenegg, J.: Die Sacrale Methode des Exstirpation von Mastdarmkrebsen nach Prof. Kraske, Wien. klin. Wchnschr. **1**:254, 272, 290, 309, 324 and 348, 1888; Beiträge zur Chirurgie des Rectum und der Beckenorgane, ibid. **2**:515, 1889.

6. Babcock, W. W.: One Stage Simplified Proctosigmoidectomy with Formation of Perineal Anus, S. Clin. North America **12**:1397, 1932.

7. Bacon, H. E.: Evolution of Sphincter Muscle Preservation and Re-establishment of Continuity in the Operative Treatment of Rectal and Sigmoidal Cancer, Surg., Gynec. & Obst. **81**:113, 1945

CHANGE IN OBJECTIVE

Until 1908, the objective in extirpation of rectal carcinoma was preservation of the sphincter mechanism and reestablishment of bowel continuity except when the anal canal was primarily involved. At this time, Miles[8] altered the objective of preserving the sphincter mechanism. Based on the lymphatic and anatomic studies of Poirier, Cunéo and Delamere,[9] he contended that cancer of the rectum extended in three directions or zones, i.e., upward, laterally and downward. With a wider excision of tissues in these zones of spread, accomplished by the more radical abdominoperineal excision, including the entire sphincter muscle area, and establishment of a permanent abdominal colostomy, there was a decided increase in the percentage of cures. This so-called Miles operation, in one or two stages, continues to be the most popular procedure. Over the last forty years, with improvements in technic, better knowledge of fluid balance and the use of blood and the introduction of antibiotics, this operation—particularly the one stage procedure—has resulted in the lowest rates of mortality and morbidity and the greatest percentage of cures.

During these last forty years, however, there have been sporadic attempts to develop a technic which would be sufficiently radical to extirpate all malignant tissue and would preserve the sphincter muscle mechanism. All surgeons with a proper surgical conscience serve their patients with three purposes, namely: (1) preserving life, (2) eradication of disease and (3) preservation and restoration of function. Sometimes in the sincere attempts to make progress in managing a condition, differences of opinion arise as to whether or not a promoted change or scheme of execution is a true advancement. Surgical consciences vary, and I cite the turmoil in a surgeon's mind when he realizes a certain operation carries a higher rate of mortality but a higher percentage of cures as balanced against the operation for the same condition with a lower rate of mortality but a lower percentage of cures. Such a conflict exists when one balances the radical Miles operation against the sphincter-preserving operation for carcinoma of the rectum, because one feels that the ratio of cures will be higher with the more radical procedure. However, knowledge of the rates of mortality and morbidity and the percentage of cures in malignant conditions of the rectum with sphincter preservation is based on surgical experience, most of it previous to the last thirty years. In this time, technical abilities have advanced, preoperative and postoper-

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8. Miles, W. E.: A Method of Performing Abdominoperineal Excision for Carcinoma of the Rectum and of the Terminal Portion of the Pelvic Colon, Lancet **2**:1812, 1908.

9. Poirier, P., in Cunéo, B., and Delamere, G.: The Lymphatics, Chicago, Keener & Co., 1904.

ative care have improved because of greater knowledge and use of fluids, plasma, blood, vitamins and antibiotics, and surgeons have some additional knowledge of the pathologic changes and treatment of cancer. Some might say that the anatomic and physiologic aspects are the same but it is possible for clinical interpretation to change. Under this change in conditions, some older methods for treatment of rectal carcinoma, with or without modification, are now being re-explored and reevaluated.

STUDIES ON LYMPH NODES

The true basis for the renewed attempts at reestablishing bowel continuity in this type of malignant condition is the studies on lymph nodes in removed specimens and autopsy material by McVay;[10] Wood and Wilkie;[11] Westhuer, Gabriel, Dukes and Bussey; Gilchrist and David; Coller, Kay and McIntyre, and Grinnell.[12] Their studies revealed that dissemination of cancer cells of the rectum in a downward direction is unusual unless the lymph nodes above the tumor are blocked by metastases. In the collection of 507 cases by the authors just mentioned, only 8 had nodes involved below the lesion. Studies by Glover and Waugh[13] substantiated the conclusions of the previous investigators. Also, the intramural spread of cancer cells below the lower margin of the tumor is rare. A clearance of at least 1 inch (2.5 cm.), and preferably 2 inches (5 cm.), is usually a safe margin. This is a challenge to Miles's teachings. Where extensive involvement of glands is not present and the tumor is not particularly large or invasive, a less radical excision of the rectum and anus would certainly result in eradication of the disease in some instances. This point cannot be denied, but the percentage of cures is debatable at this time.

As to lateral spread, the surgeon's greatest concern is at the levator ani level. Here there are lymph nodes extending outward over the upper surface of this muscle to the hypogastric nodes, and cancer cells from a tumor adjacent to this muscle could spread into these lymph nodes. It would seem that with lesions situated in the last 3 inches (7.5 cm.) of the rectum, removal of at least part of this muscle should always be considered, as it is in the routine abdominoperineal technics. To remove the adjacent muscle tissue, fascia and lymph nodes

10. McVay, J. R.: Involvement of the Lymph Nodes in Carcinoma of the Rectum, Ann. Surg. **76**:755, 1922.

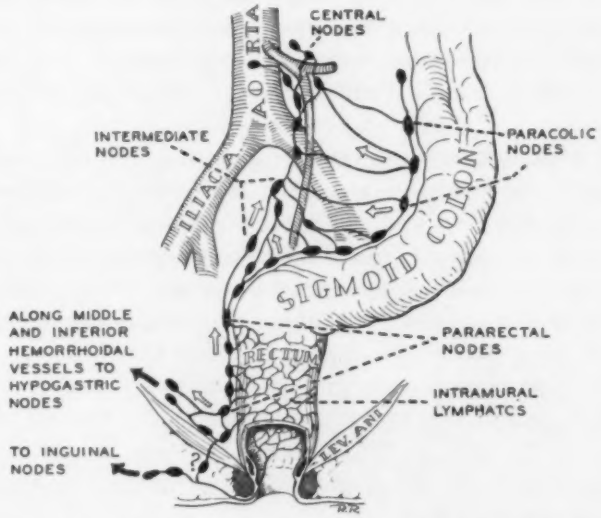
11. Wood, W. Q., and Wilkie, D. P. D.: Carcinoma of the Rectum: Anatomical-Pathological Study, Edinburgh M. J. **40**:321, 1933.

12. Grinnell, R. S.: The Lymphatic and Venous Spread of Carcinoma of the Rectum, Ann. Surg. **116**:200, 1942.

13. Glover, R. P., and Waugh, J. M.: The Retrograde Lymphatic Spread of Carcinoma of the Rectosigmoid Region, Surg., Gynec. & Obst. **82**:434, 1946.

requires posterior incision and anastomosis. If this is true, some surgeons are attempting to remove too many low-lying rectal carcinomas and performing the anastomosis from within the abdomen because they have satisfactorily mastered the technic. It is suggested that with lesions at the 7.5 cm. level (3 inches) or even a little higher, the levator fascia and muscle should be excised.

The question also arises of lymph nodes piercing the levator ani muscle and fascia, thus permitting spread downward from higher lesions or spread upward from lower lesions. Dr. James Blair and I have been working on this problem for over a year, and we are about ready to publish the data. In general, at this time, lymphatic channels through these structures seem to be rather rare.



Lymph channels and nodes to be considered in the spread of rectal and rectosigmoid carcinoma.

Upward spread through lymphatic channels is undeniable. However, the usual course taken in the upward dissemination is somewhat debatable. Evidence seems to favor the fact that cancer cells in the paracolic glands along the mesenteric margin of the rectosigmoid and sigmoid tend to travel medially toward the intermediate glands or central glands (figure) until these glands become blocked and force spread along the paracolic channels. It is not denied that at times the higher paracolic channels may be involved when the intermediate and central nodes are not involved. This permits one to be a little more conservative in the amount of bowel to remove above the lesion and leave sufficient length of colon for the low anastomosis. However, one must not become too conservative on this premise, as it can only invite danger and a higher incidence of early recurrence.

FACTORS IN EVALUATION OF PROCEDURES

In the evaluation of procedures for preservation of sphincter muscle and function, one must examine the rates of mortality, three and five year survivals and morbidity, the degree of continence and the element of impotence in male patients.

Regarding the incidence of mortality in the one stage abdominoperineal resection, Rankin[14] reported 7 per cent, Jones[15] reported 7.2 per cent and Cattell[16] reported 6.5 per cent. These are rather representative figures among patients from private practice. Charity clinics carry a higher rate of mortality, for obvious reasons. In the various types of radical abdominoperineal operations with sphincter preservation, Dixon[17] reported one series with a 12.1 per cent rate of mortality and a later smaller series with 4.9 per cent. Mahorner[18] reported 7.6 per cent in a small group, Wangensteen[19] 7.4 per cent and Fallis[20] 6.5 per cent. Babcock[6] and Bacon,[7] in a rather large series of "pull through" operations, reported a 6.6 per cent rate of mortality.

At the present time, most of the comparisons on cure can take into account only the unfortunate results of operation previous to forty years ago. At that time end results were deplorable, but one must not forget that practically all operations for sphincter preservation were posterior attacks, and certainly results today with colostomy and posterior resection do not equal those of the abdominoperineal operation. One must be fair in all aspects of the comparison and evaluation. With the radical abdominoperineal excision that Miles advocated, the three and five year cures are averaging around 50 per cent. It will be another five to ten years before there are satisfactory and comparable reports on the cure of rectal carcinoma by the sphincter-preservation operations.

It is my opinion that the rate of morbidity in sphincter-preservation operations might be higher, because an incontinent posterior sphincter area or draining fecal fistula is much more troublesome than

14. Rankin, F. W.: How Surgery of the Colon and Rectum Developed, Surg., Gynec. & Obst. **64**:705, 1937; The Choice of Operative Methods for Carcinoma of the Rectum, Surgery **7**:667, 1940.

15. Jones, T. E.: Consideration of Elective Surgical Procedures in Various Segments of the Colon, Surgery **14**:342, 1943.

16. Cattell, R. B.: Carcinoma of the Colon and Rectum, Surgery **14**:378, 1943.

17. Dixon, C. F.: Anterior Resection for Carcinoma Low in the Sigmoid and Rectosigmoid, Surgery **15**:367, 1944.

18. Mahorner, H.: Restoration of Continuity After Resection of the Rectum, Ann. Surg. **123**:866, 1946.

19. Wangensteen, O. H.: Primary Resection of Rectal Ampulla for Malignancy with Preservation of Sphincteric Function, Surg., Gynec. & Obst. **81**:1, 1945.

20. Fallis, L. S.: Anterior Resection of Rectosigmoid and Upper Rectum with Re-Establishment of Continuity, Surgery **14**:397, 1943.

the average abdominal colostomy. Babcock and Bacon classified 80 per cent of their patients as continent following their modified "pull through" operation, but added that 40 per cent of the patients must wear a protective pad or dressing. In other words, only 40 per cent of their patients were able to go without a protective dressing. From the few reports in the literature, discussions with other surgeons and my own personal experiences in a relatively small group of cases[21] in which anastomosis of the rectum has been completed from within the abdomen or when it has been completed posteriorly by a modified Kraske technic following abdominal dissection, it is my interpretation that anal sphincter control is much more satisfactory. In the cases in which a fistula does develop and does not heal over within a few weeks, the condition is not satisfactory. When fecal drainage persists, it is observed that the patient is much more comfortable and better satisfied after a colostomy is done. In the period previous to the rapid surgical advances of the last twenty-five years, when the objective was maintenance of the sphincter mechanism, Koerbl[22] of the Eiselsberg Klinic reported continence in only 36 per cent when the Hochenegg technic was employed, but with the Kraske method 66 per cent were continent. Gesung,[23] at an early period, recorded satisfactory continence in 75 per cent of his cases of anastomosis. At the present time, it appears that satisfactory continence may be expected in 80 per cent to 90 per cent of the cases in which anastomosis is completed in sphincter-saving procedures.

As for impotence in the male patients, all surgeons are aware that this is a frequent complication following abdominoperineal resection. In fact, Jones,[15] who has collected data on this factor, expressed the belief that it approaches 95 per cent. From present reports, this complication does not arise so frequently when the sphincter is preserved.

Technically, and from my experience, any operation restoring bowel continuity in the rectal region is more difficult and time consuming. Few surgeons now advocate a preliminary colostomy, the greater number performing a complemental colostomy or cecostomy, and a few complete the anastomosis without a colostomy or cecostomy. In the "pull through" operation as favored by Babcock and Bacon no colon drainage is established, but a rectal tube is tied into the protruding bowel. Wangensteen does not usually employ a colon decom-

21. Best, R. R.: (*a*) Progress in the Elimination of Permanent Colostomies in Carcinoma of the Rectum and Rectosigmoid, Nebraska M. J. **31**:406, 1946; (*b*) Selection of Operative Procedure to Avoid Colostomy in Carcinoma of Rectum and Rectosigmoid, Surg., Gynec. & Obst., to be published.

22. Koerbl, H.: Continenzverhältnisse nach den radicalen Operationen des Mastdarmkrebses, Arch. f. klin. Chir. **10**:449, 1913.

23. Gesung, R.: Ein dauernd geheilter Fall von Carcinoma recti, Wien. med. Wchnschr. **28**:710, 1878.

pression measure, but depends on nasogastric suction. Mahorner favors a catheter in the sigmoid. Dixon is reluctant to do an anastomosis without a complemental colostomy. Murray[24] and Fallis insert a rectal catheter through and up beyond the line of anastomosis. I always do a cecostomy if the anastomosis is completed from within the abdomen, and if it is done through a posterior incision either a cecostomy or a rectal tube is used. In view of the number of minor, and the occasional major, breakdowns that occur in the line of these low anastomoses, it would seem that a complemental decompressive measure is indicated. From my own experience at this time, the cecostomy is a happy medium between the more radical colostomy and the less efficient and uncomfortable nasogastric or nasointestinal tube. The cecostomy closes without difficulty if properly done. When a breakdown does occur, the rectal tube is of little value in promoting healing, and it does not diminish colon traffic over the fistula area. At the present time, I am convinced that the presacral cavity should always be drained posteriorly.

As to the type of procedure to be followed if intestinal continuity and rectal sphincter control are to be preserved, the modified "pull through" operation championed by Babcock has been used in the greatest number of cases. The percentage of cases with anal continence seems to be debatable. In lesions of the rectosigmoid and upper rectal limits, it is not the most satisfactory procedure, and in lesions of the middle and lower part of the rectum, it has not been widely accepted. It appears that more satisfactory sphincter control has resulted from some type of anastomosis. However, breakdown of the suture line does occur in cases of anastomosis, resulting in a minor fistula which usually heals in a few weeks, or an occasional severe fistula or stricture may later require an abdominal colostomy. The abdominal colostomy is an improvement over the perineal colostomy or a leaking discharging anus.

PROCEDURES FOR ANASTOMOTIC TYPE OF OPERATION

If one chooses to do an operation of the anastomotic type, one may select one of three procedures, i.e., abdominal dissection, resection and anastomosis; abdominal dissection with perineal resection and anastomosis, and perineal dissection with perineal resection and anastomosis. In lesions of the rectosigmoid and immediately adjacent lesions of the upper part of the rectum, dissection and anastomosis can be accomplished from within the abdomen. Likewise, those lesions lower than the upper part of the rectum, in fact those within 5 cm. (2 inches), can be resected and abdominal anastomosis accomplished,

24. Murray, G.: Resection of the Rectum with Reconstruction of Canal Through the Perineal Approach, Surg., Gynec. & Obst. **82**:283, 1946.

but probably those lesions at the 7.5 cm. (3 inch), or midrectal level, should have abdominal dissection and posterior resection with anastomosis to insure adequate removal of lymph nodes or infiltrated tissues of the levator ani muscle and fascia. The perineal phase of the operation enables one to remove lymphatic tissue on the surfaces of the levator ani muscle and to excise malignant tissue which may extend out into this muscle or fascia. The strongest support for the third type of operation, perineal dissection with perineal resection and anastomosis, is its expediency in a patient of poor risk. Certainly, it does not adhere to the basic principles of radical surgical procedure for cancer.

In a series of 22 cases of carcinoma of the rectosigmoid and rectum which I reported,[21b] in which intestinal continuity was restored and sphincter mechanism preserved, there were 2 deaths, a rate of operative mortality of .9 per cent. It is my impression that this mortality rate can be kept between 5 and 10 per cent. I have noted some difficulty with inadequate healing of the suture line and troublesome fistulas. In several of these cases two to four months were required before drainage ceased, and in 1 case I performed a temporary colostomy, which was later closed. In 1 case a rectovaginal fistula developed, which required four months for complete healing. In a number of cases, usually those with temporary fistulas, narrowing developed at the site of the anastomosis that required repeated dilations.

Incontinence has not been a troublesome factor. A few patients feel a strong urgency, but have learned by experience immediately to seek the proper place to relieve themselves. Most patients have the desire to relieve themselvs three to four times daily, which may be because of a more liquid stool or from some feeling of insecurity. Frank discussions with 2 male patients, both of whom had undergone abdominal resection and anastomosis, revealed retention of sexual function. Discussions with 2 other male patients, for whom the operation was that of abdominal dissection, posterior resection and anastomosis, revealed that one felt competent and the other believed he had lost this function.

COMMENT

For estimating the three and five year cures, one must patiently wait for the results. It is possible that the figures for the radical abdominoperineal excision without sphincter preservation will not be reached, but, if the percentage of cures is within 10 per cent, it may behoove surgeons to present the problem to the individual patient and allow him to choose to take the lessened chance of cure with preservation of that mechanism which rightfully belongs to him.

DISCUSSION

DR. RAYMOND W. MCNEALY, Chicago: I think that Dr. Best has touched on one of the most controversial subjects—that of management of carcinoma of the rectum. I personally have not been able to keep apace with the vacillations and variations in this type of surgical procedure.

I feel that we were getting to the place where we were of the opinion that an abdominoperineal resection with an abdominal colostomy gave the best results in carcinoma of the rectum. Patients were taught how to manage a colostomy, and the medical profession was well acquainted with the correct position of a colostomy.

When one compromises with carcinoma of the rectum, I feel that it is like the virgin who compromises with virtue—she is very likely to find herself with a slight touch of pregnancy. When the surgeon compromises with wide complete excision of carcinoma in the initial operation, he is likely to find local recurrences.

If one does an abdominoperineal resection, one has the best chance of cure. If one compromises with that and preserves the sphincter, one will effect about 60 per cent efficient sphincter control but there will be a perceptible loss in the efficiency of the operation.

Abdominoperineal resection is well within the ability of most of the men who are doing general surgical work. The "pull through" and sphincter-retention anastomosis type of operation is thoroughly and efficiently accomplished only in the hands of men who do it regularly. To do an occasional operation of this type is not very satisfactory. All operations which preserve the sphincter and depend on anastomosis, either from the abdomen or from the perineal side, must make some compromise with a thorough excision of the rectum and perirectal tissue.

The controversy relative to when certain nodes become blocked by carcinoma and the carcinoma begins to metastasize in another direction is equivocal, and no surgeon, even though his experience be great, has any real idea of the direction before he operates. Without carrying a controversial subject any further, I would say that for the majority of men an abdominoperineal resection has given the best results. Any compromise with this, to secure possible sphincter control, is a matter for each surgeon to decide.

DR. HARRY B. ZIMMERMAN, St. Paul: I think that the chief reason for trying to preserve the sphincter function is that the patient is so distressed over the outlook of a permanent abdominal colostomy that he will not readily consent to have such a procedure done. In this connection, I think that there are some psychologic factors rather important for a surgeon to recognize.

First, I usually have 1 or 2 patients on whom I have successfully done abdominal perineal resections who are sufficiently happy over their results to be willing to speak to the person I intend to operate on. I select those who are well nourished, have happy dispositions and are enthusiastic about results, and they see patients occasionally, before I operate on them, and tell them that an abdominal colostomy is not a thing to be dreaded. They tell the patients that they have had abdominal colostomies for years and nobody was aware of the fact and that they are doing their work and indulging in other activities. One woman models and sells dresses, and no one suspects that she has had such an operation. Another patient, an efficient farm woman who does all her household chores, is well nourished and a happy person. She is a helpful example. In order to get such healthy persons with abdominal colostomies, it is important to teach them to use such an abdominal colostomy and to educate certain conditioned reflexes in the lower bowel, and this can be done.

In the first place, a bag of any kind is a nuisance, and it does not work. I make my colostomies in the umbilicus. It is an easy place to put them. They are not so likely to shrink and cause strictures. I put a pad over that and a belt over the umbilicus, which shields them sufficiently unless something serious happens. Then, as soon as the patient is up, in the prescribed early ambulation of today, the nurse has little to do with the care of the colostomy. The patient is told right away, "You are going to take care of that right now, while you are in the hospital, so that you will have less difficulty when you get out." Certain times a day, beginning twice, later once, the patient gets up, goes to a dressing room and makes an attempt to expel the feces from the colostomy, cleans it up and puts a dressing on it. This may have to be done many times during the day, but gradually, for some reason—and I think that we have all had that experience—it will become regulated. There are many things which condition the bowel-moving reflex, and that can be conditioned by the patient. If patients are very messy, they do not like it and will dress themselves. Eventually these persons will get to the point where one day they will prepare themselves for a bowel movement, and the bowel movement will occur through the colostomy without much effort. They are not continually being messed up with it. This is a psychologic problem. It has to do with the education of a conditioned reflex, but it obviates the difficulty one has with an abdominal colostomy. It obviates the necessity for preserving the sphincter.

I am sure that I am not competent to do the "pull through" operation successfully, and I am certainly not competent to do a low anastomosis successfully, but I do not believe that most of my patients who have had the abdominal perineal resection are especially unhappy persons.

DR. WALTER G. MADDOCK, Chicago: I should like to mention my experience along this line and present some thoughts that I have on this subject. Dr. McNealy has well emphasized here that the operative treatment presented by Dr. Best certainly belongs in the hands of the experts and that by and large the vast majority of the general surgeons will do better with the combined abdominoperineal resection. The latter is by far an easier type of operation than any involving a preservation of the anal sphincter. I am doing more combined abdominoperineal resections than other operations for carcinoma of the rectum, but in the past eighteen months I have excised six such tumors and preserved the sphincters.

The question as to whether a rectal carcinoma has spread extensively is not an easy one. Dukes and his associates in England tried to answer the question by a study of 400 cases, and in addition asked themselves, "What would we do if we knew beforehand all of the information that we had after the pathologist had looked over the specimen?" Their conclusion was that in about a third of the cases a local procedure, that is, the perineal resection as it is done in England, would have resulted in a cure; in another third of the cases no operation, a sphincter-preserving one or the radical Miles procedure would have resulted in a cure, and a final third of the cases fall in between these groups.

The six carcinomas of the rectum that I have resected with preservation of the sphincter have all been done through a combined abdominoperineal approach, the anastomosis being carried out through the posterior wound. In the last patient the line of suture was within a centimeter of the mucocutaneous line. Of these 6 patients, 1 had to have the anastomosis operation converted at the end of seven days into a straight combined abdominoperineal procedure, because the lower end of the sigmoid became gangrenous. Through the abdominal wound the sloughing bowel was excised and a stab wound left lower quadrant sigmoid colostomy was made. Convalescence was uneventful. The other 5 patients have good sphincter function at the present time. In 3 cases there was failure of the posterior anastomosis to heal primarily. In 2 of these the fistula healed spontaneous-

ly, 1 in three weeks and 1 in about six weeks. In the third case a rectovaginal fistula developed, which I think, was due to a too deep suture which went through the posterior wall of the vagina. A temporary transverse colostomy was done at the time of the fistula, and later the fistula and the colostomy were closed. It is apparent that one has more difficulty with a sphincter-preserving procedure than with the Miles combined abdominoperineal operation.

It is true from all studies of the lymphatic spread of carcinoma of the rectum that extension down the lymph nodes is of rare occurrence. In Glover and Waugh's series of 100 cases of far advanced cancer, there was only 1 with a retrograde extension in which the mass of nodes above were not completely blocked. In 8 of their total of 9 cases in which cancerous nodes were observed more than 1 cm. below the primary carcinoma, the majority of the nodes around and above the primary cancer were blocked by carcinoma.

I think that one can select some cases from the number seen in which a preservation of the sphincter can be considered. The resection and anastomosis can often be done from an anterior approach, as employed by Dixon, Wangensteen and others, or by the abdominoperineal route, as I have used. The latter should permit the removal of a greater amount of bowel below the primary tumor and a lower anastomosis, within 1 to 3 cm. from the mucocutaneous line. I had a patient recently with a 2 by 3 cm. lesion approximately 9 cm. above the anus. The tumor projected into the rectum and was freely movable and not ulcerated. Dukes has pointed out that such carcinomas have probably not gone through the bowel wall and therefore offer a good chance of cure by a procedure other than the Miles technic. The situation was discussed with the patient, but it was apparent that possible difficulty with primary healing of the anastomosis would not be satisfactory to her, so that I did a straight combined abdominoperineal resection. The gross specimen showed the carcinoma to be 2 by 3 cm. as I have mentioned. The pathologist reported that there were no lymph nodes involved, that there was no venous involvement and that the local lesion extended out to but not into the muscularis of the bowel. The preoperative opinion that a sphincter-preserving operation could have been done in this case with an excellent possibility of cure was borne out by a study of the specimen after the operation.

I do not believe that all carcinomas of the rectum have to have the Miles combined abdominoperineal resection. I think that some selection can be made and a colostomy avoided. The selection must be made carefully, and I think that it must be made by men who have had considerable experience with surgical intervention on the colon.

DR. R. RUSSELL BEST, Omaha: I do not wish to take up any more time, except to reemphasize the last remark of Dr. Maddock, and that is that all patients should not have an anastomosis or a "pull through" operation, nor should all patients have an abdominoperineal resection. I believe it wise to take the middle channel at this time. I wish to take the opportunity to thank Dr. McNealy, Dr. Zimmerman and Dr. Maddock for their discussions.